31ST REPORT OF THE MALAYSIAN DIALYSIS & TRANSPLANT REGISTRY



2023

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MALAYSIAN SOCIETY OF NEPHROLOGY

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2023

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The success of the Registry depends on you.

The Ministry of Health, Malaysia.

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ABOUT THE MALAYSIAN DIALYSIS AND TRANSPLANT REGISTRY (MDTR)

The Malaysia Dialysis and Transplant Registry (MDTR) collects information on patients with end stage kidney disease (ESKD) on renal replacement therapy (RRT) in Malaysia.

Objectives:

The objectives of the registry are as follows:

1. **Describe the natural history of ESKD**. The registry shall describe the characteristics of patients with ESKD, its management, patient survival and quality of life outcomes with treatment; and shall describe variation thereof across different groups, healthcare sectors or geographic regions, and its secular trend over time in Malaysia.

2. **Determine effectiveness of treatments for ESKD**. The registry shall determine clinical effectiveness and cost effectiveness of treatments of ESKD in real-world clinical practices in Malaysia.

3. **Monitor safety and harm of products and services used in the treatment of ESKD**. The registry shall serve as an active surveillance system for the occurrence of unexpected or harmful events for products and services.

4. **Evaluating access to and quality of treatment services for ESKD.** The registry shall assess differences between providers or patient populations based on performance measures that compare treatments provided or outcomes achieved with "gold standards" (e.g., evidence-based guidelines) or comparative benchmarks for specific health outcomes (e.g., risk-adjusted survival rates). Such programs may be used to identify disparities in access to care, demonstrate opportunities for improvement, establish differentials for payment by third parties, or provide transparency through public reporting.

5. **To maintain the national renal transplant waiting list electronically – the eMyKAS or electronic Malaysian Kidney Allocation System.** The electronic-MyKAS (e-MyKAS) system will generate an auto e-mail to the Person-In-charge (PIC) and Nephrologist in-charge (NIC) of the patients high on the list. The PIC or NIC will need to counsel and obtain consent and identify any contraindications to transplantation.

Once the patients have completed medical, surgical, and psycho-social assessments, they will be assessed at designated transplant centres to determine their fitness for transplant surgery, following which they will be placed in the active waiting list for a deceased kidney transplant.

The MyKAS list will be re-run on a yearly basis. The outcome of the MyKAS system will be evaluated on a yearly basis and the allocation criteria will be revised every 3 years.

Registry design:
This is a multi-centre, observational cohort study designed to evaluate the health outcomes of patients with ESKD undergoing treatment at participating clinical centres. Patient inclusion criterion is deliberately broad and shall include any patient with a confirmed diagnosis of ESKD.

There is no prescribed study visits. Patient shall attend the clinical site as and when required per the standard of care at the site. Required data shall be collected as they become available.

- A clinical site shall notify all new patients to the registry and shall continue to do so until the termination of the registry. Patients shall be follow-up for life.
- Participation. Site shall notify the patients' treatment to the registry in a calendar year of its participation. A site shall similarly notify patients during each year of its participation in the registry.

Registry study population:
The registry study population consists of male or female patients with ESKD to be recruited from participating sites in Malaysia. Participation in this study is voluntary. However, in accordance with the Private Health-care Facilities Act 1998 (AKTA 586), all dialysis health facilities are required to submit data to the Malaysian Dialysis and Transplant Registry (MDTR).

All clinical centres or sites that satisfy the following selection criteria will be invited to participate:
1. This registry is opened to all clinical sites that provide RRT services for patients with ESKD in Malaysia.

2. Each site shall have a Principal Investigator who is also a licensed physician / surgeon and a qualified professional experienced with ESKD management.

3. Each site shall appoint a Site Coordinator (SC). The SC is the person at the participating clinical site who is responsible for all aspects of registry management and data collection at site, and who will liaise with the Clinical Registry Manager (CRM) and Clinical Registry Assistant (CRA) at the Registry Coordinating Centre (RCC).

4. Each site shall accept responsibility for data collection, as well as for ensuring proper record keeping and registry document filing.

5. Each site shall agree to comply with the registry procedures and shall be willing to be subjected to ongoing review of data by CRM or CRA or other representative of MDTR. This may include one or more site visits by prior arrangement, if necessary.

Patient eligibility criteria:

- All new patients with ESKD undergoing treatment at a participating clinical site are eligible for entry into the registry.
- In addition, a site may opt to enter existing patients on follow-up at the site into the registry.

Registry data:
The data elements to be collected by the registry shall be relevant and reliable with modest burden to sites, shall comply with existing data standard where this exists, shall be compatible with established data set used by other existing registries, and shall employ standard terminology where available.

Two datasets are defined:

- Core dataset: These are data elements that are needed to address the key questions for which the registry was created.
- Non-core dataset: these are speculative data elements included to provide an opportunity to generate hypotheses or to explore other subsidiary questions not of primary interest to the registry.

The data domains and related specific data elements to be collected by this registry is tabulated below:

A	Identifier	Name, NRIC number, Other identifying document numbers, Address, Contact numbers
B	Demographics	Age, Sex, Ethnicity, Educational attainment, Occupation, Household Income group, Weight & Height, Use of tobacco, Funding for Treatment
C	Medical history	Medical history/ comorbidities, Family history
D	ESKD diagnosis	Date of first diagnosis, Date re- entering each RRT
E	Laboratory Investigations	Date & time of tests, Blood chemistry, Haematology, Serology
F	Treatment	Modalities of RRT - haemodialysis, peritoneal dialysis; treatment of other uraemic complications; kidney transplantation
G	Outcomes	Patient survival; death, date of death, cause of death, Quality of Life/ Work rehabilitation status
H	Economics	Source of funding for dialysis treatment, and immunosuppressive drug treatment for transplantation
I	Healthcare provider characteristics	Sector providing dialysis treatment, (private, public or NGO)

PARTICIPATING HAEMODIALYSIS CENTRES 2023

Haemodialysis Centres	AR	Haemodialysis Centres	AR
801 Rumah Sakit Angkatan Tentera (Kuching), HD Unit	≥80%	Bintulu Hospital, HD Unit	≥80%
94 Hospital Angkatan Tentera (Terendak), HD Unit	NIL	Bintulu Specialist Hospital, HD Unit	≥80%
96 Hospital Angkatan Tentera (Lumut), HD Unit	≥80%	Borneo Specialist Hospital (Miri), HD Unit	≥80%
AD Dhouha Haemodialysis Centre, HD Unit	≥80%	Borneo Specialist Hospital, HD Unit	≥80%
Aiman Dialysis Centre, HD Unit	≥80%	BP Renal Care (Kluang), HD Unit	≥80%
Al-Islam Specialist Hospital, HD Unit	≥80%	BP Renal Care (Rengit), HD Unit	≥80%
Alkom Bakti Dialysis, HD Unit	≥80%	BP Renal Care Sdn Bhd (Batu Pahat), HD Unit	≥80%
Al-Musoffa Haemodialysis Centre (Balok) Sdn Bhd, HD Unit	≥80%	BP Renal Care Simpang Renggam, HD Unit	≥80%
Al-Musoffa Haemodialysis Centre, HD Unit	≥80%	BP Renalcare (Kahang) Sdn Bhd, HD Unit	≥80%
Alor Gajah Dialysis Centre, HD Unit	≥80%	BP Renalcare (Segamat) Sdn Bhd, HD Unit	≥80%
Alor Gajah Hospital, HD Unit	≥80%	BP Renalcare (Yong Peng) Sdn Bhd, HD Unit	≥80%
Alor Setar Dialysis Centre, HD Unit	≥80%	Buddhist Tzu Chi Dialysis Centre (Butterworth), HD Unit	≥80%
Ampang Hospital, HD Unit	≥80%	Buddhist Tzu Chi HD Centre (Penang), HD Unit	≥80%
AMS Haemodialysis Centre, HD Unit	≥80%	Buddhist Tzu-Chi Dialysis Centre (Kedah), HD Unit	≥80%
Anson Bay Medical Centre, HD Unit	≥80%	Bukit Mertajam Hospital, HD Unit	≥80%
Asia Renal Care (KL), HD Unit	≥80%	Bukit Tinggi Medical Centre, HD Unit	≥80%
Asia Renal Care (KL), HD Unit	≥80%	Carlatan Dialysis Centre (Bukit Mertajam), HD Unit	≥80%
Assunta Hospital, HD Unit	≥80%	Carlatan Dialysis Centre (Sungai Petani), HD Unit	≥80%
Aura Renal Sdn Bhd, HD Unit	≥80%	Changkat Melintang Hospital, HD Unit	≥80%
Avisena Dialysis Centre Seri Kembangan, HD Unit	≥80%	Che Eng Khor Centre, HD Unit	≥80%
Avisena Dialysis Centre, HD Unit	≥80%	Cheras Dialysis Centre, HD Unit	≥80%
Avisena Dialysis Setia Alam, HD Unit	≥80%	CHKMUS-MAA Medicare Charity, HD Unit	≥80%
B. Braun Avitum (Butterworth) Dialysis Centre, HD Unit	≥80%	Columbia Asia Hospital (Tebrau), HD Unit	≥80%
B. Braun Avitum (Kota Kinabalu) Dialysis Centre, HD Unit	≥80%	Columbia Asia Hospital Klang, HD Unit	≥80%
B. Braun Avitum (Puchong) Dialysis Centre, HD Unit	≥80%	Coop Dialisis, HD Unit	≥80%
B. Braun Avitum (Tawau) Dialysis Centre, HD Unit	≥80%	Dahlia Dialysis Centre (Batu Gajah), HD Unit	≥80%
Bahiah Dialysis Centre, HD Unit	≥80%	Dahlia Dialysis Centre (Teluk Intan), HD Unit	≥80%
Bakti-NKF Dialysis Centre, HD Unit	≥80%	Dahlia Dialysis Centre, HD Unit	≥80%
Balik Pulau Hospital, HD Unit	≥80%	Dalat Hospital, HD Unit	≥80%
Baling Hospital, HD Unit	≥80%	Damai Dialysis (Merlimau), HD Unit	≥80%
Bangi Dialysis Centre, HD Unit	≥80%	Damai Dialysis Sdn Bhd (Masjid Tanah), HD Unit	≥80%
Banting Hospital, HD Unit	≥80%	Damansara Premier Dialysis Centre, HD Unit	≥80%
Batu Gajah Hospital, HD Unit	≥80%	Damansara Specialist Hospital, HD Unit	≥80%
Bau Hospital, HD Unit	≥80%	Darul Aman Ventures, HD Unit	≥80%
Beaufort Hospital, HD Unit	≥80%	Darul Naim Dialisis, HD Unit	≥80%
Beluran Hospital, HD Unit	≥80%	Dialisis Ajil, HD Unit	≥80%
Bentong Hospital, HD Unit	≥80%	Dialisis Al-Ariff (Eco Majestic), HD Unit	≥80%
Bertam Dialysis Centre, HD Unit	≥80%	Dialisis An Nur Taqwa Sdn Bhd, HD Unit	<80%
Besut Hospital, HD Unit	≥80%	Dialisis Dr Zur Sdn Bhd (Cawangan Alor Setar), HD Unit	≥80%
Betong Hospital, HD Unit	≥80%	Dialisis Dr Zur Sdn Bhd, HD Unit	NIL

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
Dialisis Jertih, HD Unit	≥80%	Hospital Bera, HD Unit	≥80%
Dialisis Pakar Kemaman, HD Unit	≥80%	Hospital Cyberjaya, HD Unit	≥80%
Dialisis Sri Andalas, HD Unit	≥80%	Hospital Daerah Daro, HD Unit	≥80%
Dkasih Hemodialisis (Gemas), HD Unit	≥80%	Hospital Enche' Besar Hajjah Khalsom, HD Unit	≥80%
Dkasih Hemodialisis (Jempol), HD Unit	≥80%	Hospital Pakar An-nur Specialist Hospital, HD Unit	≥80%
D'kasih Hemodialisis (Seremban), HD Unit	≥80%	Hospital Pakar Sultanah Fatimah (Muar), HD Unit	≥80%
Dr. Mokhtar Medical & Hemodialysis, HD Unit	≥80%	Hospital Pusrawi, HD Unit	≥80%
DSS Dialysis Centre (Rawang), HD Unit	≥80%	Hospital Queen Elizabeth II, HD Unit	≥80%
Duchess of Kent Hospital, HD Unit	≥80%	Hospital Sultanah Hajjah Kalsom, HD Unit	≥80%
Dungun Hospital, HD Unit	≥80%	Hospital Sultanah Maliha Langkawi, HD Unit	≥80%
Eagles Dialysis Centre Berhad, HD Unit	≥80%	Hospital Sultanah Nora Ismail, HD Unit	≥80%
EAM Dialysis Centre, HD Unit	≥80%	Hospital Tunku Azizah, Kuala Lumpur (Paed), HD Unit	≥80%
Falah Nephrocare, HD Unit	≥80%	Hospital Wanita Dan Kanak-kanak Sabah (Paed), HD Unit	≥80%
Fatimah Hospital, HD Unit	≥80%	Hospital Wanita Dan Kanak-Kanak Sabah, HD Unit	≥80%
Foresight Dialysis Bandar Tasik Kesuma, HD Unit	≥80%	Hudaz Dialysis Centre Pasir Pekan, HD Unit	≥80%
Foresight Dialysis Padang Serai, HD Unit	≥80%	Hudaz Tunjong Dialysis Centre, HD Unit	≥80%
Foresight Dialysis Pasir Puteh, HD Unit	≥80%	Hulu Terengganu Hospital, HD Unit	≥80%
Foresight Dialysis Tasek Gelugor, HD Unit	≥80%	Ibnu Al-Nafis Dialysis Centre, HD Unit	≥80%
Georgetown Specialist Hospital, HD Unit	≥80%	IIUM Dialysis Centre, HD Unit	≥80%
Gerik Hospital, HD Unit	≥80%	Institut Jantung Negara, HD Unit	NIL
Gleneagles Kota Kinabalu, HD Unit	≥80%	Island Hospital, HD Unit	≥80%
Gleneagles Kuala Lumpur, HD Unit	≥80%	Jasin Hospital, HD Unit	≥80%
Gleneagles Medini, HD Unit	≥80%	Jelebu Hospital, HD Unit	≥80%
Gleneagles Penang, HD Unit	≥80%	Jeli Hospital, HD Unit	≥80%
Gua Musang Hospital, HD Unit	≥80%	Jempol Hospital, HD Unit	≥80%
Haemodialysis Centre Yayasan Toh Puan Zurina, HD Unit	≥80%	Jengka Hospital, HD Unit	≥80%
Haemodialysis Unit Ara Damansara Medical Centre, HD Unit	≥80%	Jerantut Hospital, HD Unit	≥80%
Haemodialysis Yakin Prima Ampang, HD Unit	≥80%	JHM- Rotary Haemodialysis Centre (Penang), HD Unit	≥80%
Haemodialysis Yakin Prima Jaya, HD Unit	≥80%	Jitra Hospital, HD Unit	≥80%
Haemodialysis Yakin Prima PD, HD Unit	<80%	JJ Lions Dialysis Centre, HD Unit	≥80%
Happy Kid Nees Dialysis Centre, HD Unit	≥80%	Johor Specialist Hospital, HD Unit	≥80%
Harmony Sofia Dialysis Centre, HD Unit	≥80%	JQA Dialysis Foundation, HD Unit	≥80%
Harmony Vision Dialysis Centre, HD Unit	≥80%	Kaizenbros Dialysis Centre, HD Unit	≥80%
HDU Tatau (Bintulu), HD Unit	≥80%	Kajang Hospital, HD Unit	≥80%
Healthcare Dialysis Centre, HD Unit	≥80%	Kampar Hospital, HD Unit	≥80%
Hemodialisis Bukit Payong, HD Unit	≥80%	Kanowit Hospital, HD Unit	≥80%
Hemodialisis Nefro Bakti, HD Unit	≥80%	Kapit Hospital, HD Unit	≥80%
Hemodialisis Paka, HD Unit	≥80%	Kay Tee Dialisis, HD Unit	≥80%
Hemodialisis Yayasan Veteran ATM (S Kembangan), HD Unit	≥80%	Kek Lok Si Charitable Hospital, HD Unit	≥80%
Hospital Angkatan Tentera Tuanku Mizan, HD Unit	≥80%	Kemaman Hospital, HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
Keningau Hospital, HD Unit	≥80%	Kuala Lumpur Lions Renal Centre, HD Unit	≥80%
Kepala Batas Hospital, HD Unit	≥80%	Kuala Nerang Hospital, HD Unit	≥80%
Klinik Kesihatan Bandar Mas, HD Unit	≥80%	Kuala Penyu Hospital, HD Unit	≥80%
Klinik Kesihatan Batu Niah, HD Unit	≥80%	Kuantan Clinical Diagnostic Centre, HD Unit	≥80%
Klinik Kesihatan Debak, HD Unit	≥80%	Kuantan Dialysis Centre, HD Unit	≥80%
Klinik Kesihatan Kemahang, HD Unit	≥80%	Kuching Specialist Hospital, HD Unit	≥80%
Klinik Kesihatan Mahligai, HD Unit	≥80%	Kudat Hospital, HD Unit	≥80%
Klinik Kesihatan Nabawan, HD Unit	≥80%	Kulim Hospital, HD Unit	≥80%
Klinik Kesihatan Pangkor, HD Unit	≥80%	Kunak Hospital, HD Unit	≥80%
Klinik Kesihatan Song, HD Unit	≥80%	Labuan Hospital, HD Unit	≥80%
Klinik Kesihatan Sungai Lembing, HD Unit	≥80%	Lahad Datu Hospital, HD Unit	≥80%
Klinik Putra Dan Pusat Rawatan Dialisis, HD Unit	≥80%	Lam Wah Ee Hospital, HD Unit	≥80%
Klinik Waqaf An-Nur (Ijok), HD Unit	≥80%	Lawas Hospital, HD Unit	≥80%
KMI Kuantan Medical Centre, HD Unit	≥80%	Leo Dialysis Centre, HD Unit	≥80%
Kota Belud Hospital, HD Unit	≥80%	Lim Boon Sho Dialysis Centre, HD Unit	≥80%
Kota Kinabatangan Hospital, HD Unit	≥80%	Limbang Hospital, HD Unit	≥80%
Kota Marudu Hospital, HD Unit	≥80%	Lions Club Kota Budaya Dialysis Centre, HD Unit	≥80%
Kota Tinggi Hospital, HD Unit	≥80%	Loh Guan Lye Specialist Centre, HD Unit	≥80%
KPJ Ampang Puteri Specialist Hospital, HD Unit	≥80%	Lundu Hospital, HD Unit	≥80%
KPJ Bandar Maharani Specialist Hospital, HD Unit	≥80%	Machang Hospital, HD Unit	≥80%
KPJ Batu Pahat Specialist Hospital, HD Unit	≥80%	Mahkota Medical Centre, HD Unit	≥80%
KPJ Hemodialysis Kluang, HD Unit	≥80%	MAHSA Dialysis Centre, HD Unit	≥80%
KPJ Kajang Specialist Hospital, HD Unit	≥80%	MAIDAM Hospital Besut, HD Unit	≥80%
KPJ Klang Specialist Hospital (1), HD Unit	≥80%	Marudi Hospital, HD Unit	≥80%
KPJ Klang Specialist Hospital (2), HD Unit	≥80%	MB Star Rawatan Dialisis (Hutan Melintang), HD Unit	≥80%
KPJ Kuantan Dialysis Centre, HD Unit	≥80%	MB Star Rawatan Dialisis (Kelana Jaya), HD Unit	≥80%
KPJ Penang Specialist Hospital, HD Unit	≥80%	MB Star Rawatan Dialisis (Teluk Intan), HD Unit	≥80%
KPJ Perdana Specialist Hospital, HD Unit	≥80%	MB Star Rawatan Dialisis Puchong Utama, HD Unit	≥80%
KPJ Puteri Specialist Hospital, HD Unit	≥80%	MDZ Haemodialysis Centre, HD Unit	<80%
KPJ Rawang Specialist Hospital, HD Unit	≥80%	Mediway Dialysis, HD Unit	≥80%
KPJ Sabah Specialist Hospital, HD Unit	≥80%	Melaka Hospital, HD Unit	≥80%
KPJ Selangor Specialist Hospital, HD Unit	≥80%	Mentakab Haemodialysis Unit, HD Unit	≥80%
KPJ Sentosa KL Specialist Hospital, HD Unit	≥80%	Mersing Hospital, HD Unit	≥80%
KPJ Seremban Specialist Hospital, HD Unit	≥80%	Mersing Rotary Haemodialysis Centre, HD Unit	≥80%
KPJ Tawakkal Health Centre, HD Unit	≥80%	Metro Specialist Hospital, HD Unit	≥80%
Kuala Kangsar Hospital, HD Unit	≥80%	Miri Hospital, HD Unit	≥80%
Kuala Krai Hospital, HD Unit	≥80%	MNA Renal Care Dialysis Centre Sdn Bhd, HD Unit	≥80%
Kuala Kubu Bharu Hospital, HD Unit	≥80%	Muadzam Shah Hospital, HD Unit	≥80%
Kuala Lipis Hospital, HD Unit	≥80%	Muar Dialysis, HD Unit	≥80%
Kuala Lumpur Hospital, HD Unit	≥80%	Muar Lions Renal Centre, HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
Muhibah Renal Care, HD Unit	≥80%	Pantai Hospital Batu Pahat, HD Unit	≥80%
Mukah Hospital, HD Unit	≥80%	Pantai Hospital Cheras, HD Unit	≥80%
Mykidney Dialysis Centre, HD Unit	NIL	Pantai Hospital Ipoh, HD Unit	≥80%
Mynephro Dialysis Sdn Bhd, HD Unit	≥80%	Pantai Hospital Klang, HD Unit	≥80%
Myrenal Dialisis Centre, HD Unit	≥80%	Pantai Hospital Laguna Merbok, HD Unit	≥80%
Mysha Qasih Dialysis Centre, HD Unit	≥80%	Pantai Hospital Penang, HD Unit	≥80%
Nefrocare Haemodialysis (SKC) Sdn Bhd, HD Unit	≥80%	Pantai Hospital Sungai Petani, HD Unit	≥80%
Nefrocare Heamodialysis, HD Unit	≥80%	Pantai-ARC Dialysis Services, HD Unit	≥80%
NEPH Dialysis Centre Sdn Bhd, HD Unit	≥80%	Papar Hospital, HD Unit	≥80%
Neph Sdn Bhd (Sg Ara), HD Unit	≥80%	Parit Buntar Hospital, HD Unit	≥80%
Nephcare Dialysis Centre (Cawangan Umbai), HD Unit	≥80%	Pasir Gudang Specialist Hospital, HD Unit	≥80%
Nephcare Dialysis Centre, HD Unit	≥80%	Pasir Mas Hospital, HD Unit	≥80%
Nilai Dialysis Centre, HD Unit	≥80%	Pekan Hospital, HD Unit	≥80%
Nobel Dialysis Centre (Beaufort), HD Unit	≥80%	Pelangi Haemodialysis, HD Unit	≥80%
Nobel Dialysis Centre (Kota Belud), HD Unit	≥80%	Penang Adventist Hospital, HD Unit	≥80%
Nobel Dialysis Centre (Kota Kinabalu), HD Unit	≥80%	Penang Caring Dialysis Society, HD Unit	≥80%
Nobel Dialysis Centre (Tuaran), HD Unit	≥80%	Perak Community Specialist Hospital, HD Unit	≥80%
Normah Medical Specialist Centre, HD Unit	≥80%	Perkhidmatan Hemodialisis Raudhah Dialisis Centre, HD Unit	≥80%
Northern Dialysis Centre, HD Unit	≥80%	Persada Dialysis Centre, HD Unit	≥80%
NSCMH 1 Dialysis Care, HD Unit	≥80%	Persatuan Amal Chin Malaysia Barat, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Bahau, HD Unit	≥80%	Persatuan Buah Pinggang Sabah, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Gemas, HD Unit	≥80%	Persatuan Buah Pinggang Sandakan Sabah, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Kuala Pilah, HD Unit	≥80%	Persatuan Dialisis Cahaya Kuching, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Lukut, HD Unit	≥80%	Persatuan Dialisis Kurnia Petaling Jaya, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Mantin, HD Unit	≥80%	Persatuan Dialisis Masjid Jamek Sultan Abdul Aziz, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Rantau, HD Unit	≥80%	Persatuan Haemodialysis Klang, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Sepang, HD Unit	≥80%	Persatuan Hemodialisis Sacred Hope, Kuching, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Seputeh, HD Unit	≥80%	Persatuan Hemodialysis Kinabalu Sabah, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Seri Kembangan, HD Unit	≥80%	Persatuan Kebajikan Haemodialisis St Anne BM, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Tawau, HD Unit	≥80%	Persatuan Kebajikan Pusat Haemodialisis Masjid At-Taqwa, HD Unit	≥80%
NSCMH Dialysis Care Cawangan Yong Peng, HD Unit	≥80%	Persatuan Membaiki Akhlak-Che Luan Khor_NKF, HD Unit	≥80%
Nucare Dialysis Centre, HD Unit	≥80%	Pertubuhan Bakti Fo En Bandar Kulim, HD Unit	≥80%
Nur Dialysis Centre, HD Unit	≥80%	Pertubuhan Dialisis Rotary-Satu Hati, HD Unit	≥80%
Nur Iman Dialysis Pahang Sdn Bhd, HD Unit	≥80%	Pertubuhan Haemodialisis Hope (Ipoh), HD Unit	≥80%
Nur Iman Dialysis Pahang, HD Unit	≥80%	Pertubuhan Hemodialisis Muhibbah Segamat (Cawangan Jementah), HD Unit	≥80%
Oriental Melaka Straits Medical Centre, HD Unit	≥80%	Pertubuhan Hemodialisis Muhibbah Segamat (Labis), HD Unit	≥80%
Pahang Buddhist Association Haemodialysis Centre (Mentakab), HD Unit	≥80%	Pertubuhan Hemodialisis Muhibbah Segamat, HD Unit	≥80%
Pahang Buddhist Association, HD Unit	≥80%	Pertubuhan Hemodialysis Seberang Perai Selatan, HD Unit	≥80%
Pantai Hospital Ampang, HD Unit	≥80%	Pertubuhan Kebajikan Amitabha, HD Unit	≥80%
Pantai Hospital Ayer Keroh, HD Unit	≥80%	Pertubuhan Perkhidmatan Hemodialisis Nor Kasih Larut Matang dan Selama Perak, HD unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
Pertubuhan Perkhimatan Dialisis Amal Sitiawan, Perak, HD Unit	NIL	Pusat Dialisis Ahmad Khalif, HD Unit	≥80%
Peter Mole MAA-Medicare Charity Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Aiman Cheras, HD Unit	≥80%
Pitas Hospital, HD Unit	≥80%	Pusat Dialisis Aiman Shah Alam, HD Unit	≥80%
Platinum Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Airah, HD Unit	≥80%
PMA Chan Meng Khor-MAA Medicare Charity Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Albukhary, HD Unit	≥80%
Pontian Hospital, HD Unit	≥80%	Pusat Dialisis Al-Ehsan, HD Unit	≥80%
Pontian Rotary Haemodialysis Centre, HD Unit	≥80%	Pusat Dialisis Al-Hayat, HD Unit	≥80%
Port Dickson Hospital, HD Unit	≥80%	Pusat Dialisis Amal MAA MEDICARE, HD Unit	≥80%
Premier Renal Care, HD Unit	≥80%	Pusat Dialisis Amal MAA-Medicare (Kota Bharu), HD Unit	≥80%
Prima Dialisis Kluang, HD Unit	≥80%	Pusat Dialisis Amandanau, HD Unit	≥80%
Prima Dialisis Lagenda Putra, HD Unit	≥80%	Pusat Dialisis An-Nur (Pasir Gudang), HD Unit	≥80%
Prima Dialisis Nusajaya, HD Unit	≥80%	Pusat Dialisis An'nur Seksyen 13, HD Unit	≥80%
Prima Dialisis Pekan Nanas, HD Unit	≥80%	Pusat Dialisis Ar Rahman Bachok Kelantan, HD Unit	≥80%
Prima Dialysis Masai, HD Unit	≥80%	Pusat Dialisis Ar Rahman Ketereh, HD Unit	≥80%
Prince Court Medical Centre, HD Unit	≥80%	Pusat Dialisis Bulan Sabit Merah Miri , HD Unit	≥80%
Prodiso Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Bulan Sabit Merah Permyjaya Miri, HD Unit	≥80%
Pulau Pinang Hospital, HD Unit	≥80%	Pusat Dialisis Cahaya Samarahan, HD Unit	≥80%
Pusat Amal Hemodialisis Dato' Lee Kok Chee, HD Unit	≥80%	Pusat Dialisis Cahaya, HD Unit	≥80%
Pusat Cakna Dialisis, HD Unit	≥80%	Pusat Dialisis CAT Negeri Pulau Pinang, HD Unit	≥80%
Pusat Dialisis & Kesihatan Masjid Bandar Baru Uda, HD Unit	≥80%	Pusat Dialisis Davita Alor Setar, HD Unit	≥80%
Pertubuhan Perkhimatan Dialisis Amal Sitiawan, Perak, HD Unit	NIL	Pusat Dialisis Davita Bandar Baru Uda, HD Unit	≥80%
Peter Mole MAA-Medicare Charity Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Davita Bangi, HD Unit	≥80%
Pitas Hospital, HD Unit	≥80%	Pusat Dialisis Davita Bangsar, HD Unit	≥80%
Platinum Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Davita Batang Berjuntai, HD Unit	≥80%
PMA Chan Meng Khor-MAA Medicare Charity Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Davita Benut, HD Unit	≥80%
Pontian Hospital, HD Unit	≥80%	Pusat Dialisis Davita Cheras, HD Unit	≥80%
Pontian Rotary Haemodialysis Centre, HD Unit	≥80%	Pusat Dialisis Davita Gurun	≥80%
Port Dickson Hospital, HD Unit	≥80%	Pusat Dialisis Davita Johor Bahru, HD Unit	≥80%
Premier Renal Care, HD Unit	≥80%	Pusat Dialisis Davita Kajang, HD unit	≥80%
Prima Dialisis Kluang, HD Unit	≥80%	Pusat Dialisis Davita Kangar, HD Unit	≥80%
Prima Dialisis Lagenda Putra, HD Unit	≥80%	Pusat Dialisis Davita Klang, HD Unit	≥80%
Prima Dialisis Nusajaya, HD Unit	≥80%	Pusat Dialisis Davita Kota Damansara, HD Unit	≥80%
Prima Dialisis Pekan Nanas, HD Unit	≥80%	Pusat Dialisis Davita Kota Kinabalu, HD Unit	≥80%
Prima Dialysis Masai, HD Unit	≥80%	Pusat Dialisis Davita Kota Tinggi, HD Unit	≥80%
Prince Court Medical Centre, HD Unit	≥80%	Pusat Dialisis Davita Kota Warisan, HD Unit	NIL
Prodiso Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Davita Kuala Pilah, HD Unit	≥80%
Pulau Pinang Hospital, HD Unit	≥80%	Pusat Dialisis Davita Kuala Sungai Baru, HD Unit	≥80%
Pusat Amal Hemodialisis Dato' Lee Kok Chee, HD Unit	≥80%	Pusat Dialisis Davita Masjid Tanah, HD Unit	≥80%
Pusat Cakna Dialisis, HD Unit	≥80%	Pusat Dialisis Davita Meru, HD Unit	≥80%
Pusat Dialisis & Kesihatan Masjid Bandar Baru Uda, HD Unit	≥80%	Pusat Dialisis Davita Papar, HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
Pusat Dialisis Davita Pekan Baru, HD Unit	NIL	Pusat Dialisis Intan, HD Unit	≥80%
Pusat Dialisis Davita Pendang, HD Unit	≥80%	Pusat Dialisis Jasmine, HD Unit	≥80%
Pusat Dialisis Davita Puchong, HD Unit	≥80%	Pusat Dialisis JL, HD Unit	≥80%
Pusat Dialisis Davita Rembau, HD Unit	≥80%	Pusat Dialisis Klinik Kesihatan Simpang Renggam, HD Unit	≥80%
Pusat Dialisis Davita Sandakan, HD Unit	≥80%	Pusat Dialisis Klinik Waqaf An-nur Masjid Al-Ismaili, HD Unit	≥80%
Pusat Dialisis Davita Seberang Perai, HD Unit	≥80%	Pusat Dialisis Lestari, HD Unit	≥80%
Pusat Dialisis Davita Seremban, HD Unit	≥80%	Pusat Dialisis Mahmood Dialysis Centre Gua Musang, HD Unit	≥80%
Pusat Dialisis Davita Sg. Petani Selatan, HD Unit	≥80%	Pusat Dialisis MAIDAM, HD Unit	≥80%
Pusat Dialisis Davita Sg. Petani Utara, HD Unit	≥80%	Pusat Dialisis MAIS (Melawati), HD Unit	≥80%
Pusat Dialisis Davita Sri Rampai, HD Unit	≥80%	Pusat Dialisis MAIS (Shah Alam), HD Unit	≥80%
Pusat Dialisis Davita Sungai Besar, HD Unit	≥80%	Pusat Dialisis MAIS Cawangan Bukit Jelutong, HD Unit	≥80%
Pusat Dialisis Davita Taman Seri Setia, HD Unit	≥80%	Pusat Dialisis MAIS Cawangan Kapar, HD Unit	≥80%
Pusat Dialisis Davita Taman Tasik Jaya, HD Unit	≥80%	Pusat Dialisis MAIS Cawangan Sungai Besar, HD Unit	≥80%
Pusat Dialisis Davita Tanjung Karang, HD Unit	≥80%	Pusat Dialisis MAIS, HD Unit	≥80%
Pusat Dialisis Davita Wangsa Maju, HD Unit	≥80%	Pusat Dialisis Majlis Ugama Islam dan Adat Resam Melayu Pahang (Cawangan Gambang), HD Unit	≥80%
Pusat Dialisis De' Langkap, HD Unit	≥80%	Pusat Dialisis Majlis Ugama Islam dan Adat Resam Melayu Pahang (Cawangan Jengka), HD Unit	≥80%
Pusat Dialisis Dhuha, HD Unit	≥80%	Pusat Dialisis Majlis Ugama Islam dan Adat Resam Melayu Pahang, HD Unit	≥80%
Pusat Dialisis Dungun, HD Unit	≥80%	Pusat Dialisis Makmur (Batu Gajah), HD Unit	≥80%
Pusat Dialisis Ehsan Perak (Bagan Serai) 2_HD Unit	≥80%	Pusat Dialisis Marjina (Ayer Hitam), HD Unit	≥80%
Pusat Dialisis FN, HD Unit	≥80%	Pusat Dialisis Marjina, HD Unit	≥80%
Pusat Dialisis Foresight Dialysis Bandar Puncak Alam, HD Unit	≥80%	Pusat Dialisis Mediway (Cawangan Bandar Puteri Puchong), HD Unit	≥80%
Pusat Dialisis Foresight Dialysis Bandar Saujana Putra, HD Unit	≥80%	Pusat Dialisis Mediway (Cawangan Kuala Kubu Bharu), HD Unit	≥80%
Pusat Dialisis Foresight Dialysis Bukit Payong, HD Unit	≥80%	Pusat Dialisis Mesra (Kuala Selangor), HD Unit	≥80%
Pusat Dialisis Foresight Dialysis Nilai, HD Unit	NIL	Pusat Dialisis Muafakat, HD Unit	≥80%
Pusat Dialisis Foresight Dialysis Padang Midin, HD Unit	≥80%	Pusat Dialisis Mukmin Bahau, HD Unit	≥80%
Pusat Dialisis Foresight Dialysis Pantai Marang, HD Unit	≥80%	Pusat Dialisis Mukmin Bandar Sri Permaisuri, HD Unit	≥80%
Pusat Dialisis Foresight Dialysis Pokok Sena, HD Unit	≥80%	Pusat Dialisis Mukmin Gurun, HD Unit	≥80%
Pusat Dialisis Foresight Dialysis Sungai Petani, HD Unit	≥80%	Pusat Dialisis Mukmin Ipoh, HD Unit	≥80%
Pusat Dialisis Foresight Dialysis Tok Bali, HD Unit	≥80%	Pusat Dialisis Mukmin Kuala Lipis, HD Unit	≥80%
Pusat Dialisis Hariz, HD Unit	≥80%	Pusat Dialisis Mukmin Salak Tinggi, HD Unit	≥80%
Pusat Dialisis Hudaz Pasir Mas, HD Unit	≥80%	Pusat Dialisis Mukmin Seremban, HD Unit	≥80%
Pusat Dialisis Hudaz Tumpat Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Mukmin Sikamat, HD Unit	≥80%
Pusat Dialisis Ibnu Sina (Kuala Ketil), HD Unit	≥80%	Pusat Dialisis Mukmin Simpang Ampat, HD Unit	≥80%
Pusat Dialisis Ideal, HD Unit	≥80%	Pusat Dialisis Mukmin Sri Andalas, HD Unit	≥80%
Pusat Dialisis Ikhlas, HD Unit	≥80%	Pusat Dialisis Mukmin Sungai Buloh, HD Unit	≥80%
Pusat Dialisis Iman, HD Unit	≥80%	Pusat Dialisis Mukmin Telok Panglima Garang, HD Unit	≥80%
Pusat Dialisis IMU Dialysis Centre, HD Unit	≥80%	Pusat Dialisis Mukmin Temerloh, HD Unit	≥80%
Pusat Dialisis Indah (Banting), HD Unit	≥80%	Pusat Dialisis Murni, HD Unit	≥80%
Pusat Dialisis Indah (Subang Jaya), HD Unit	≥80%	Pusat Dialisis Mustapha Kamal, HD Unit	≥80%
Pusat Dialisis Indah (Sungai Buloh), HD Unit	≥80%	Pusat Dialisis Mutiara (Ayer Tawar), HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR
Pusat Dialisis Mutiara (Cawangan), HD Unit	≥80%
Pusat Dialisis Mutiara, HD Unit	≥80%
Pusat Dialisis My Angkasa (Temerloh), HD Unit	≥80%
Pusat Dialisis Myangkasa (K. Kedah), HD Unit	≥80%
Pusat Dialisis Nefro Utama (Pontian), HD Unit	≥80%
Pusat Dialisis Nephrocare (Bukit Piatu), HD Unit	≥80%
Pusat Dialisis Nephrocare (Cawangan Bandar Penawar), HD Unit	≥80%
Pusat Dialisis Nephrocare (Cawangan Batang Kali)	≥80%
Pusat Dialisis Nephrocare (Cawangan Bukit Gambir), HD Unit	≥80%
Pusat Dialisis Nephrocare (Cawangan Pendang), HD Unit	≥80%
Pusat Dialisis Nephrocare (Klang), HD Unit	≥80%
Pusat Dialisis Nephrocare Global (Cawangan Kajang), HD Unit	≥80%
Pusat Dialisis Nephrocare Global (Cawangan Senawang), HD Unit	≥80%
Pusat Dialisis Nephrocare Global (Cawangan Sri Rampai), HD Unit	≥80%
Pusat Dialisis Nephrocare Global (Cawangan Sungai Besar), HD Unit	≥80%
Pusat Dialisis Nephrocare Global (Cawangan Tanjung Karang), HD Unit	≥80%
Pusat Dialisis NKF- Bonuslink (Kota Bharu), HD Unit	≥80%
Pusat Dialisis NKF- Dato' Dr GA Sreenevasan, HD Unit	≥80%
Pusat Dialisis NKF- Fo Yi (Unit I), HD Unit	≥80%
Pusat Dialisis NKF Nanyang Setapak, HD Unit	≥80%
Pusat Dialisis NKF-BonusLink Yayasan Buah Pinggang Kebangsaan Malaysia, HD Unit	≥80%
Pusat Dialisis NKF-Calvary, HD Unit	≥80%
Pusat Dialisis NKF-Charis Cheras, HD Unit	≥80%
Pusat Dialisis NKF-Chempaka, HD Unit	≥80%
Pusat Dialisis NKF-Fo Yi (Unit II), HD Unit	≥80%
Pusat Dialisis NKF-Kelab Apex, HD Unit	≥80%
Pusat Dialisis NKF-Kelab Lions Alor Star, HD Unit	≥80%
Pusat Dialisis NKF-Kidney Association of Sarawak Rotary (Unit 2), HD Unit	≥80%
Pusat Dialisis NKF-Kidney Association of Sarawak Rotary, HD Unit	≥80%
Pusat Dialisis NKF-Rotary Damansara, HD Unit	≥80%
Pusat Dialisis NKF-Sang Riang (Triang), HD Unit	≥80%
Pusat Dialisis NKF-Yayasan Buah Pinggang Kemaman, HD Unit	≥80%
Pusat Dialisis NKF-Yayasan Dialisis Pertubuhan Pendidikan Akhlak Taiping, HD Unit	≥80%
Pusat Dialisis NKF-Yayasan Dialysis Pendidikan Akhlak Perak, HD Unit	≥80%
Pusat Dialisis NKF-Yayasan Pembangunan Keluarga Darul Ta'zim, HD Unit	≥80%
Pusat Dialisis NKF-Yayasan Sultanah Bahiyah, HD Unit	≥80%
Pusat Dialisis Nucare Dialysis Centre Sdn. Bhd. (Cawangan Nibong Tebal), HD Unit	≥80%
Pusat Dialisis Nur Kasih (Kamunting), HD Unit	≥80%
Pusat Dialisis Nur Kasih (Parit Buntar), HD Unit	≥80%
Pusat Dialisis Nur Kasih (Taiping), HD Unit	≥80%
Pusat Dialisis Nur Kasih Sdn Bhd (Cawangan Lenggong), HD Unit	≥80%
Pusat Dialisis Nur Kasih Sdn Bhd (Cawangan Seremban), HD Unit	≥80%
Pusat Dialisis Nur Kasih Sdn Bhd (Cawangan Tanjung Rambutan), HD Unit	≥80%
Pusat Dialisis Nuraeen, HD Unit	≥80%
Pusat Dialisis Nusa Bestari Dialysis Sdn Bhd, HD Unit	≥80%
Pusat Dialisis Orion Consortium, HD Unit	≥80%
Pusat Dialisis Pakar (Kuantan), HD Unit	≥80%
Pusat Dialisis Pakar (Pekan), HD Unit	≥80%
Pusat Dialisis Pakar Medi-Nefron (Lestari), HD Unit	≥80%
Pusat Dialisis Pakar Medi-Nefron (Putra Permai), HD Unit	≥80%
Pusat Dialisis Pelangi Sdn Bhd, HD Unit	≥80%
Pusat Dialisis Pengkalan Hulu, HD Unit	≥80%
Pusat Dialisis Perbadanan Islam (Johor Bahru), HD Unit	≥80%
Pusat Dialisis Perbadanan Islam (Pontian), HD Unit	≥80%
Pusat Dialisis Perbadanan Islam Johor (Ayer Hitam), HD Unit	≥80%
Pusat Dialisis Perbadanan Islam Johor (Taman Rinting), HD Unit	≥80%
Pusat Dialisis Perbadanan Islam Mersing, HD Unit	≥80%
Pusat Dialisis Perdana, HD Unit	≥80%
Pusat Dialisis PERKESO (Cawangan Batu Pahat), HD Unit	≥80%
Pusat Dialisis PERKESO (Cawangan Klang), HD Unit	≥80%
Pusat Dialisis PERKESO (Cawangan Kluang), HD Unit	≥80%
Pusat Dialisis PERKESO (Cawangan Shah Alam), HD Unit	≥80%
Pusat Dialisis Pertama Kepala Batas, HD Unit	≥80%
Pusat Dialisis Pertama Rawang, HD Unit	<80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR
Pusat Dialisis PPBPT, HD Unit	≥80%
Pusat Dialisis Prima, HD Unit	≥80%
Pusat Dialisis Qaseh PKPP, HD Unit	≥80%
Pusat Dialisis Rakyat (Lembah Keramat), HD Unit	≥80%
Pusat Dialisis Rakyat Ampang, HD Unit	≥80%
Pusat Dialisis Rakyat Sementa, HD Unit	≥80%
Pusat Dialisis Rakyat Taman Medan, HD Unit	≥80%
Pusat Dialisis Remedic Kodiang, HD Unit	NIL
Pusat Dialisis Renal Care Dialysis Services Sdn Bhd, HD Unit	≥80%
Pusat Dialisis Renal Pure, HD Unit	≥80%
Pusat Dialisis Renal-Link (Papar), HD Unit	≥80%
Pusat Dialisis Serai Wangi (Bukit Mertajam), HD Unit	≥80%
Pusat Dialisis Serai Wangi, HD Unit	≥80%
Pusat Dialisis Setia (Ipoh), HD Unit	≥80%
Pusat Dialisis Setia (Sitiawan), HD Unit	≥80%
Pusat Dialisis Sijangkang, HD Unit	≥80%
Pusat Dialisis Sinar Amal- PDSA Cawangan Ipoh, HD Unit	≥80%
Pusat Dialisis Sinar Amal- PDSA Cawangan Kampar, HD Unit	≥80%
Pusat Dialisis Sinar Care, HD Unit	≥80%
Pusat Dialisis Subang, HD Unit	≥80%
Pusat Dialisis Tabung Rawatan Pesakit Buah Pinggang Seberang Perai, HD Unit	≥80%
Pusat Dialisis Taiping (Cawangan Kamunting), HD Unit	≥80%
Pusat Dialisis Taiping (Parit Buntar), HD Unit	≥80%
Pusat Dialisis Taiping Cawangan Kuala Kangsar, HD Unit	≥80%
Pusat Dialisis Taiping, HD Unit	≥80%
Pusat Dialisis Tanjung Malim, HD Unit	≥80%
Pusat Dialisis Tanjung Renal Care Centre, HD Unit	≥80%
Pusat Dialisis Terengganu/NKF, HD Unit	≥80%
Pusat Dialisis Touch, HD Unit	≥80%
Pusat Dialisis Velmed, HD Unit	≥80%
Pusat Dialisis Veteran ATM (Senawang), HD Unit	≥80%
Pusat Dialisis Waqaf An Nur Masjid Taman Bukit Tiram, HD Unit	≥80%
Pusat Dialisis Waqaf An-Nur Galleria @ Kotaraya, HD Unit	≥80%
Pusat Dialisis Waqaf An-Nur Mains Rembau, HD Unit	≥80%
Pusat Dialisis Yayasan PHIM (Batu 6), HD Unit	NIL
Pusat Dialisis Yayasan PHIM, HD Unit	≥80%
Pusat Dialisis Yayasan Veteran ATM (Bukit Sentosa), HD Unit	≥80%
Pusat Dialisis Yayasan Veteran ATM (Cawangan Batang Kali), HD Unit	≥80%
Pusat Dialisis Yayasan Veteran ATM (Sunway Batu Caves), HD Unit	≥80%

Haemodialysis Centres	AR
Pusat Dialisis Zara, HD Unit	≥80%
Pusat Dialysis Azalea, HD Unit	≥80%
Pusat Dialysis Bandar Parkland, HD Unit	≥80%
Pusat Dialysis Comfort, HD Unit	≥80%
Pusat Dialysis Davita Sabak Bernam, HD Unit	≥80%
Pusat Dialysis Makmur (Senai), HD Unit	≥80%
Pusat Dialysis Mesra (Rahman Putra), HD Unit	≥80%
Pusat Dialysis Mesra Kapar, HD Unit	≥80%
Pusat Dialysis Nur Kasih (Cawangan Klang), HD Unit	≥80%
Pusat Dialysis Nur Kasih (Kuala Kangsar), HD Unit	≥80%
Pusat Dialysis Pertama Sri Manja, HD Unit	≥80%
Pusat Dialysis Remedic, HD Unit	≥80%
Pusat Dialysis Tuanku Syed Putra-NKF, HD Unit	≥80%
Pusat Dialysis UMS-YKN, HD Unit	≥80%
Pusat Dialysis YKN Pantai Dalam, HD Unit	≥80%
Pusat Haemodialisis Algazel, HD Unit	≥80%
Pusat Haemodialisis Bacang Melaka, HD Unit	≥80%
Pusat Haemodialisis Dr Ismail (Cawangan Guar Chempedak), HD Unit	≥80%
Pusat Haemodialisis Dr. Ismail, HD Unit	≥80%
Pusat Haemodialisis Rotary, Batu Pahat, HD Unit	≥80%
Pusat Haemodialisis RTC Terengganu, HD Unit	≥80%
Pusat Haemodialisis Suria (Tampin), HD Unit	≥80%
Pusat Haemodialisis Suria (Tangkak), HD Unit	≥80%
Pusat Haemodialisis Well Care, HD Unit	≥80%
Pusat Haemodialisis Zakat (Bayan Lepas), HD Unit	≥80%
Pusat Haemodialisis Zakat (Nibong Tebal), HD Unit	≥80%
Pusat Haemodialisis Zakat Kedah, HD Unit	≥80%
Pusat Hemodialisis 1 Malaysia Maras, HD Unit	≥80%
Pusat Hemodialisis 1KOPDBKL Sdn Bhd, HD Unit	≥80%
Pusat Hemodialisis Afiat Care, HD Unit	≥80%
Pusat Hemodialisis Al Falah Haemodialysis Centre Sdn Bhd, HD Unit	≥80%
Pusat Hemodialisis Al Husna, HD Unit	≥80%
Pusat Hemodialisis Alfaisal, HD Unit	≥80%
Pusat Hemodialisis Amal Lexin, HD Unit	≥80%
Pusat Hemodialisis Amethyst, HD Unit	≥80%
Pusat Hemodialisis An Nur Hemodialysis Sdn. Bhd., HD Unit	≥80%
Pusat Hemodialisis Anjung Dialysis Centre, HD Unit	≥80%
Pusat Hemodialisis Ar Rahmah Sendirian Berhad, HD Unit	≥80%
Pusat Hemodialisis Ar-Raudhah, HD Unit	≥80%
Pusat Hemodialisis Arrraudhah (Gambir), HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
Pusat Hemodialisis As-Salam, HD Unit	≥80%	Pusat Hemodialisis Harmoni Hemodialisis (Cawangan Lubok China), HD Unit	≥80%
Pusat Hemodialisis Attibbiyyin Dialisis, HD Unit	≥80%	Pusat Hemodialisis Harmoni Hemodialisis (Cawangan Nilai), HD Unit	≥80%
Pusat Hemodialisis Baheej Haemodialysis Sdn Bhd (Cawangan Jenderam), HD Unit	≥80%	Pusat Hemodialisis Harmoni Hemodialisis (Cawangan Pasir Besar), HD Unit	≥80%
Pusat Hemodialisis Balik Pulau, HD Unit	≥80%	Pusat Hemodialisis Harmoni Hemodialisis (Cawangan Rantau), HD Unit	≥80%
Pusat Hemodialisis Bayan Baru, HD Unit	≥80%	Pusat Hemodialisis Harmoni Hemodialisis (Cawangan Seri Menanti), HD Unit	≥80%
Pusat Hemodialisis Beng Siew, HD Unit	≥80%	Pusat Hemodialisis Harmoni Hemodialisis (Cawangan Sungai Pelek), HD Unit	≥80%
Pusat Hemodialisis Berkat Seroja Machang, HD Unit	≥80%	Pusat Hemodialisis Harmoni, HD Unit	≥80%
Pusat Hemodialisis Bestari Jaya, HD Unit	≥80%	Pusat Hemodialisis Hidayah, HD Unit	≥80%
Pusat Hemodialisis Bestari Kampar, HD Unit	≥80%	Pusat Hemodialisis Iman, HD Unit	≥80%
Pusat Hemodialisis BH Dialysis Centre Sdn Bhd, HD Unit	≥80%	Pusat Hemodialisis Impian Bandar Tenggara, HD Unit	≥80%
Pusat Hemodialisis Cemerlang, HD Unit	<80%	Pusat Hemodialisis Impian Kluang, HD Unit	≥80%
Pusat Hemodialisis Darul Iltizam (Ipoh), HD Unit	≥80%	Pusat Hemodialisis Impian, HD Unit	≥80%
Pusat Hemodialisis Darul Iltizam (Tapah), HD Unit	≥80%	Pusat Hemodialisis Kau Ong Yah Ampang, HD Unit	≥80%
Pusat Hemodialisis Darul Ta'zim (Batu Pahat), HD Unit	≥80%	Pusat Hemodialisis Komuniti Cheng, HD Unit	≥80%
Pusat Hemodialisis Darul Ta'zim (Parit Raja), HD Unit	≥80%	Pusat Hemodialisis KOPPES, HD Unit	≥80%
Pusat Hemodialisis Darul Ta'zim (Parit Yaani), HD Unit	≥80%	Pusat Hemodialisis Krisda Jaya (Tanjung Minyak), HD Unit	≥80%
Pusat Hemodialisis Desa Aman Puri, HD Unit	≥80%	Pusat Hemodialisis Krisda Jaya, HD Unit	≥80%
Pusat Hemodialisis Dr Azhar (Jitra), HD Unit	≥80%	Pusat Hemodialisis MAIJ, HD Unit	≥80%
Pusat Hemodialisis Dr Azhar (Kulim Lembah Impiana), HD Unit	≥80%	Pusat Hemodialisis MAIWP-PICOMS (Batu Muda), HD Unit	≥80%
Pusat Hemodialisis Fasa (Kg Medan), HD Unit	≥80%	Pusat Hemodialisis MAIWP-PICOMS (Cheras), HD Unit	≥80%
Pusat Hemodialisis Fasa (Sri Manja), HD Unit	≥80%	Pusat Hemodialisis MAIWP-PICOMS (Jln Pahang), HD Unit	≥80%
Pusat Hemodialisis Felda, HD Unit	≥80%	Pusat Hemodialisis Majlis Agama Islam Negeri Johor, HD Unit	≥80%
Pusat Hemodialisis Fomema Haemodialysis Bentong, HD Unit	≥80%	Pusat Hemodialisis Manjung, HD Unit	≥80%
Pusat Hemodialisis FOMEMA Haemodialysis Cyberjaya, HD Unit	≥80%	Pusat Hemodialisis Mawar Cawangan Pending Sarawak, HD Unit	≥80%
Pusat Hemodialisis Fomema Haemodialysis Mentakab, HD Unit	≥80%	Pusat Hemodialisis Mawar N. Sembilan (Seremban), HD Unit	≥80%
Pusat Hemodialisis Fomema Haemodialysis Merlimau, HD Unit	≥80%	Pusat Hemodialisis Medipro Alliance, HD Unit	≥80%
Pusat Hemodialisis Fomema Haemodialysis Tangkak, HD Unit	≥80%	Pusat Hemodialisis Mergong, HD Unit	≥80%
Pusat Hemodialisis Gemencheh, HD Unit	≥80%	Pusat Hemodialisis Mesra, HD Unit	≥80%
Pusat Hemodialisis Harmoni (Shamelin), HD Unit	≥80%	Pusat Hemodialisis Mutiara Pantai Remis, HD Unit	≥80%
Pusat Hemodialisis Harmoni Hemodialisis (Cawangan Bahau), HD Unit	≥80%	Pusat Hemodialisis Mutiara, HD Unit	≥80%
Pusat Hemodialisis Harmoni Hemodialisis (Cawangan Eco Majestic), HD Unit	≥80%	Pusat Hemodialisis Myangkasa, HD Unit	≥80%
Pusat Hemodialisis Harmoni Hemodialisis (Cawangan Jasin), HD Unit	≥80%	Pusat Hemodialisis Nabilah, HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
Pusat Hemodialisis NBOS Telaga Mengkudu, HD Unit	≥80%	Pusat Hemodialisis Sri Tanjung, HD Unit	≥80%
Pusat Hemodialisis Nefrol I-Care, HD Unit	≥80%	Pusat Hemodialisis Suria (Bera), HD Unit	≥80%
Pusat Hemodialisis Nilam (Semenyih), HD Unit	≥80%	Pusat Hemodialisis Suria (Jengka), HD Unit	≥80%
Pusat Hemodialisis Nour, HD Unit	≥80%	Pusat Hemodialisis Suria (Jerantut), HD Unit	≥80%
Pusat Hemodialisis Nur'ain, HD Unit	≥80%	Pusat Hemodialisis Suria (Karak), HD Unit	≥80%
Pusat Hemodialisis Paduka (Bachok), HD Unit	≥80%	Pusat Hemodialisis Suria (Kuala Krau), HD Unit	≥80%
Pusat Hemodialisis Paduka (Pasir Puteh), HD Unit	≥80%	Pusat Hemodialisis Suria (Kuala Rompin), HD Unit	≥80%
Pusat Hemodialisis Paduka (Tanah Merah 2), HD Unit	≥80%	Pusat Hemodialisis Suria (Mantin), HD Unit	≥80%
Pusat Hemodialisis Paduka (Tanah Merah), HD Unit	≥80%	Pusat Hemodialisis Suria (Muar), HD Unit	≥80%
Pusat Hemodialisis Paduka (Tumpat), HD Unit	≥80%	Pusat Hemodialisis Suria (Raub), HD Unit	≥80%
Pusat Hemodialisis Paduka, HD Unit	≥80%	Pusat Hemodialisis Suria (Senawang), HD Unit	≥80%
Pusat Hemodialisis Pagoh, HD Unit	≥80%	Pusat Hemodialisis Suria (Tampin), HD Unit	≥80%
Pusat Hemodialisis Perkis, HD Unit	≥80%	Pusat Hemodialisis Syifa (Bukit Beruntung), HD Unit	≥80%
Pusat Hemodialisis Permata, HD Unit	≥80%	Pusat Hemodialisis UniSZA, HD Unit	≥80%
Pusat Hemodialisis Persatuan Kebajikan Pusat Chee Beng Chan Banting, HD Unit	≥80%	Pusat Hemodialisis USIM-MAINS, HD Unit	≥80%
Pusat Hemodialisis Pertubuhan Wanita Prihatin Kuala Krai, HD Unit	≥80%	Pusat Hemodialisis Wakaf Terengganu, HD Unit	≥80%
Pusat Hemodialisis PMKL, HD Unit	≥80%	Pusat Hemodialisis Wakaf, Wakaf Perak Ar-Ridzuan (WPAR), HD Unit	≥80%
Pusat Hemodialisis Prihatin Tengku Besar Terengganu, HD Unit	≥80%	Pusat Hemodialisis Waqaf An-nur Bandar Baru Sultan Suleiman, HD Unit	≥80%
Pusat Hemodialisis Pusat Dialisis Bota, HD Unit	≥80%	Pusat Hemodialisis Waz Lian, HD Unit	≥80%
Pusat Hemodialisis Pusat Dialisis DE' Seri Iskandar, HD Unit	≥80%	Pusat Hemodialisis Yayasan Al-Sultan Abdullah (YASA) Jerantut, HD Unit	≥80%
Pusat Hemodialisis Qaseh (Selama), HD Unit	≥80%	Pusat Hemodialisis Yayasan Al-Sultan Abdullah (YASA) Pekan, HD Unit	≥80%
Pusat Hemodialisis Qaseh, HD Unit	≥80%	Pusat Hemodialisis Yayasan Al-Sultan Abdullah (YASA) Setiawangsa, HD Unit	≥80%
Pusat Hemodialisis Rahimra, HD Unit	≥80%	Pusat Hemodialisis Yayasan Al-Sultan Abdullah (YASA) Taman Melati, HD Unit	≥80%
Pusat Hemodialisis Seberang Takir, HD Unit	≥80%	Pusat Hemodialisis Yayasan Al-Sultan Abdullah (YASA), HD Unit	≥80%
Pusat Hemodialisis Sejahtera (Batu Pahat), HD Unit	≥80%	Pusat Hemodialisis Zakat (Balik Pulau), HD Unit	≥80%
Pusat Hemodialisis Sejahtera (Parit Jawa), HD Unit	≥80%	Pusat Hemodialisis Zakat (Bukit Mertajam), HD Unit	≥80%
Pusat Hemodialisis Sejahtera Muar, HD Unit	≥80%	Pusat Hemodialisis Zakat (Butterworth), HD Unit	≥80%
Pusat Hemodialisis Sentosa Sdn. Bhd., HD Unit	≥80%	Pusat Hemodialisis Zakat (Kepala Batas), HD Unit	≥80%
Pusat Hemodialisis Seroja (Baling), HD Unit	≥80%	Pusat Hemodialisis Zakat Georgetown, HD Unit	≥80%
Pusat Hemodialisis Seroja (Kulim 1), HD Unit	≥80%	Pusat Hemodialysis Bestari (Kepala Batas), HD Unit	≥80%
Pusat Hemodialisis Seroja (Kulim 2), HD Unit	≥80%	Pusat Hemodialysis Bestari Seri Iskandar, HD Unit	≥80%
Pusat Hemodialisis Shah Alam, HD Unit	≥80%	Pusat Hemodialysis Harmoni (Kota Damansara), HD Unit	≥80%
Pusat Hemodialisis Sinar (Jementah), HD Unit	≥80%	Pusat Hemodialysis Harmoni (Sungai Long), HD Unit	≥80%
Pusat Hemodialisis Sinar Haemodialysis Sdn Bhd (Cawangan Tampin), HD Unit	≥80%	Pusat Hemodialysis Rotary Kulai, HD Unit	≥80%
Pusat Hemodialisis Sinar Haemodialysis Sdn Bhd, HD Unit	≥80%	Pusat Hemodialysis Suria (Bentong), HD Unit	≥80%
Pusat Hemodialisis Sinar Haemodialysis, HD Unit	≥80%	Pusat Hemodialysis Suria (Temerloh), HD Unit	≥80%
Pusat Hemodialisis Sinar Kangkar Pulai, HD Unit	≥80%	Pusat Hemodialysis Suria Kuantan, HD Unit	≥80%
Pusat Hemodialisis Sinar Qaseh Dialysis Centre, HD Unit	≥80%	Pusat Hemodialysis Suria Melaka, HD Unit	≥80%
Pusat Hemodialisis Sinona, HD Unit	≥80%	Pusat Jantung Hospital Umum Sarawak, HD Unit	≥80%
Pusat Hemodialisis SJAM Pulau Sebang, HD Unit	≥80%	Pusat Pakar Dialysis Traktif, HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR
Pusat Perbadanan Islam Segamat, HD Unit	≥80%
Pusat Perubatan Ar-Ridzuan, HD Unit	≥80%
Pusat Perubatan Dialisis (Bangi), HD Unit	≥80%
Pusat Perubatan Dialisis (Dengkil), HD Unit	≥80%
Pusat Perubatan Dialisis Semenyih, HD Unit	≥80%
Pusat Perubatan Pakar Sri Kota, HD Unit	≥80%
Pusat Perubatan Sunway Velocity, HD Unit	≥80%
Pusat Perubatan Universiti Kebangsaan Malaysia, HD Unit	≥80%
Pusat Perubatan Universiti Teknologi Mara, HD Unit	≥80%
Pusat Rawatan Dialisis Afiat, HD Unit	≥80%
Pusat Rawatan Dialisis Al Farabi, HD Unit	≥80%
Pusat Rawatan Dialisis Al-Kindi, HD Unit	≥80%
Pusat Rawatan Dialisis AZ Yusra Dialysis Sdn Bhd, HD Unit	≥80%
Pusat Rawatan Dialisis Caring (Sg. Siput), HD Unit	≥80%
Pusat Rawatan Dialisis EAM Dialysis Centre, HD Unit	NIL
Pusat Rawatan Dialisis Farah Mahami, HD Unit	≥80%
Pusat Rawatan Dialisis Fazwinna, HD Unit	≥80%
Pusat Rawatan Dialisis Fitra (Cawangan Muadzam Shah), HD Unit	≥80%
Pusat Rawatan Dialisis Fitra (Kuantan), HD Unit	≥80%
Pusat Rawatan Dialisis Fitra (Maran), HD Unit	≥80%
Pusat Rawatan Dialisis Fitra (Seri Perdana), HD Unit	≥80%
Pusat Rawatan Dialisis Fitra Pekan, HD Unit	≥80%
Pusat Rawatan Dialisis Fungates Superflow-NKF, HD Unit	≥80%
Pusat Rawatan Dialisis Good Health-NKF (Kg Pandan), HD Unit	≥80%
Pusat Rawatan Dialisis H & C, HD Unit	≥80%
Pusat Rawatan Dialisis Hidayah, HD Unit	≥80%
Pusat Rawatan Dialisis Iris, HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Batu Caves), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Bukit Mertajam), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Cawangan Batu Rakit), HD Unit	NIL
Pusat Rawatan Dialisis Islah (Gong Badak), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Jerteh), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Kampung Raja), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (KL), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Kuala Berang), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Kuala Krai), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Kuala Terengganu), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Kulim), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Pasir Puteh), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Prima Sri Gombak), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Selayang), HD Unit	≥80%
Pusat Rawatan Dialisis Islah (Setiu), HD Unit	≥80%
Pusat Rawatan Dialisis MUIS-NKF, HD Unit	≥80%
Pusat Rawatan Dialisis MyKidney Dialysis Centre Rasah, HD Unit	≥80%
Pusat Rawatan Dialisis Mynephro Dialysis Sdn Bhd (Cawangan Tumpat), HD Unit	≥80%
Pusat Rawatan Dialisis NKF-Tun Abdul Razak (Kuantan), HD Unit	≥80%
Pusat Rawatan Dialisis Perdana (Cawangan Behrang), HD Unit	NIL
Pusat Rawatan Dialisis Perdana, HD Unit	≥80%
Pusat Rawatan Dialisis Pusat Dialisis Amal JB Lions Charity Dialysis Centre MAAEDICARE (1), HD Unit	≥80%
Pusat Rawatan Dialisis Pusat Dialisis Amal JB Lions Charity Dialysis Centre MAAEDICARE (2), HD Unit	≥80%
Pusat Rawatan Dialisis Pusat Dialisis Amal MAAEDICARE (Cheras), HD Unit	≥80%
Pusat Rawatan Dialisis Pusat Dialisis Amal MAAEDICARE (KL), HD Unit	≥80%
Pusat Rawatan Dialisis Pusat Dialisis Amal MAAEDICARE (Mentakab), HD Unit	≥80%
Pusat Rawatan Dialisis Pusat Dialisis Amal Maaedicare Seberang Perai, HD Unit	≥80%
Pusat Rawatan Dialisis Pusat Dialisis Nur Kasih Sdn Bhd (Cawangan Puncak Alam), HD Unit	≥80%
Pusat Rawatan Dialisis Pusat Dialisis Nur Kasih Sdn Bhd (Cawangan Putra Heights), HD Unit	≥80%
Pusat Rawatan Dialisis Pusat Hemodialisis Syukur, HD Unit	≥80%
Pusat Rawatan Dialisis Puteri Zulaikha, HD Unit	≥80%
Pusat Rawatan Dialisis Seremban Dahlia Dialysis Centre, HD Unit	≥80%
Pusat Rawatan Haemodialisis Wan Nong, HD Unit	≥80%
Pusat Rawatan Haemodialysis Pernama Haemodialysis, HD Unit	≥80%
Pusat Rawatan Hemodialisis Darul Iltizam (Slim River), HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
Pusat Rawatan Hemodialisis Dkasih Hemodialisis Sdn Bhd, HD Unit	≥80%	Sarawak General Hospital, HD Unit	≥80%
Pusat Rawatan Hemodialisis Nefro I Care, HD Unit	≥80%	Sarikei Hospital, HD Unit	≥80%
Pusat Rawatan Hemodialisis Simpang Empat Dialysis Centre, HD Unit	≥80%	Seberang Jaya Hospital, HD Unit	≥80%
Pusat Rawatan Hemodialisis Tunku Sarina, HD Unit	≥80%	Segamat Hospital, HD Unit	≥80%
Pusat Rawatan Hemodialysis Felina, HD Unit	≥80%	Selama Hospital, HD Unit	≥80%
Pusat Rawatan Perbadanan Islam (Kota Tinggi), HD Unit	≥80%	Selayang Hospital (Paed), HD Unit	≥80%
Pusat Waqaf An-nur (Senawang), HD Unit	≥80%	Selayang Hospital, HD Unit	≥80%
Putera Bistari Dialysis Centre, HD Unit	≥80%	Semporna Hospital, HD Unit	≥80%
Putra Medical Centre, HD Unit	≥80%	Serdang Hospital, HD Unit	≥80%
Putra Specialist Hospital (Melaka), HD Unit	≥80%	Seri Benut Dialysis, HD Unit	≥80%
Putrajaya Hospital, HD Unit	≥80%	Seri Manjung Hospital, HD Unit	≥80%
PWRM (BM) Dialysis Centre, HD Unit	≥80%	Seri Mutiara Dialyisis Centre Sdn Bhd, HD Unit	≥80%
Quality Dialysis Care (Jerantut), HD Unit	≥80%	Serian Dialysis Centre, HD Unit	≥80%
Queen Elizabeth Hospital, HD Unit	≥80%	Serian Hospital, HD Unit	≥80%
Raja Perempuan Zainab II Hospital, HD Unit	≥80%	Setiu Hospital, HD Unit	≥80%
Raja Permaisuri Bainun Hospital, HD Unit	≥80%	Sg Siput Hospital, HD Unit	≥80%
Ranau Hospital, HD Unit	≥80%	Shah Alam Hospital, HD Unit	≥80%
Raub Dialysis Centre Sdn Bhd, HD Unit	≥80%	Sibu Hospital, HD Unit	≥80%
Raub Hospital, HD Unit	≥80%	Sibu Kidney Foundation, HD Unit	≥80%
Rawatan Dialisis Bukit Tinggi, HD Unit	≥80%	Sik Hospital, HD Unit	≥80%
Rawatan Hemodialisis Pusat Dialysis Aquaradiance, HD Unit	≥80%	Sime Darby Medical Centre Parkcity, HD Unit	≥80%
Regency Specialist Hospital, HD Unit	≥80%	Sime Darby Medical Centre Subang Jaya, HD Unit	≥80%
Rejang Medical Centre, HD Unit	≥80%	Simunjan Hospital, HD Unit	≥80%
Rembau Hospital, HD Unit	≥80%	Sinar Haemodialysis (Batu Pahat) Sdn Bhd, HD Unit	≥80%
Renal Associates, HD Unit	≥80%	Sinar Haemodialysis (Cawangan Batu Pahat), HD Unit	≥80%
Renal Care (Ipoh Specialist), HD Unit	≥80%	Sinar Haemodialysis Sdn Bhd (Jasin, Melaka), HD Unit	≥80%
Renal Care (Kedah), HD Unit	≥80%	Sipitang Hospital, HD Unit	≥80%
Renal Dialysis Centre, HD Unit	≥80%	SJ Dialysis Centre (Ipoh), HD Unit	≥80%
Renal Life Dialysis Centre, HD Unit	≥80%	SJ Dialysis Centre (Seberang Jaya), HD Unit	≥80%
Renal Link (Penang), HD Unit	≥80%	SJ Dialysis Centre (Sg Bakap), HD Unit	≥80%
Renal Therapy Services, HD Unit	≥80%	SJ Hemodialysis Sdn Bhd (Cawangan Bidor), HD Unit	≥80%
Renal-Link (Kelantan), HD Unit	≥80%	SJ Hemodialysis Sdn Bhd (Cawangan Sungkai), HD Unit	≥80%
RenalTeam Dialysis Centre (Ara Damansara), HD Unit	≥80%	SJAMK Hemodialisis, HD Unit	≥80%
RenalTeam Dialysis Centre (Keningau), HD Unit	≥80%	SJAM-KPS Haemodialysis Centre 1 (Raja Muda Musa), HD Unit	≥80%
RenalTeam Dialysis Centre (Port Dickson), HD Unit	≥80%	SJAM-KPS Haemodialysis Centre 11 (Shah Alam), HD Unit	≥80%
Rompin Hospital, HD Unit	≥80%	SJAM-KPS Haemodialysis Centre 3 (Banting), HD Unit	≥80%
Rotary Club of Johor Bahru Haemodialysis Centre, HD Unit	≥80%	SJAM-KPS Haemodialysis Centre 5 (Rawang), HD Unit	≥80%
Rotary Club of Kota Tinggi (2019)-Hemodialisis Centre, HD Unit	≥80%	SJAM-KPS Haemodialysis Centre 6 (Kuala Selangor), HD Unit	≥80%
Sai Ananda Haemodialysis Centre, HD Unit	≥80%	SJAM-KPS Haemodialysis Centre 8 (Sibu), HD Unit	≥80%
Saratok Hospital, HD Unit	≥80%	SJAM-KPS Hemodialisis Kampar (Station 4), HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
SJAM-KPS Pusat Hemodialisis Centre 10 (Bintulu), HD Unit	≥80%	Tanah Merah Hospital, HD Unit	≥80%
SJAM-KPS Pusat Hemodialisis Centre 15 (Ipoh), HD Unit	≥80%	Tangkak Hospital, HD Unit	≥80%
SJAM-KPS Pusat Hemodialisis Klang (Station 2), HD Unit	≥80%	Tangkak Lions Renal Centre, HD Unit	≥80%
SJAM-KPS Pusat Hemodialisis Pulau Sebang (Station 9), HD Unit	≥80%	Tanjung Karang Hospital, HD Unit	≥80%
SJAM-KPS Pusat Hemodialisis Serdang Raya (Station14), HD Unit	≥80%	Tapah Hospital, HD Unit	≥80%
SJAM-KPS Pusat Hemodialisis Tasik Puteri (Station 13), HD Unit	≥80%	Tawau Hospital, HD Unit	≥80%
Slim River Hospital (Tanjong Malim), HD Unit	≥80%	Tawau Specialist Medical Centre, HD Unit	≥80%
Smart Hemodialysis, HD Unit	≥80%	Teluk Intan Hospital, HD Unit	≥80%
Smartcare Dialysis Centre (Subang Jaya), HD Unit	≥80%	Temenggong Seri Maharaja Tun Ibrahim Hospital, HD Unit	≥80%
Smartcare Dialysis Clinic (Cheras), HD Unit	≥80%	Tenang Haemodialysis Centre, HD Unit	≥80%
Sri Aman Hospital, HD Unit	≥80%	Tenang Haemodialysis Jasin, HD Unit	≥80%
Subang Dialysis Centre, HD Unit	≥80%	Tengku Ampuan Afzan Hospital (Paed), HD Unit	≥80%
Sultan Abdul Halim Hospital, HD Unit	≥80%	Tengku Ampuan Afzan Hospital, HD Unit	≥80%
Sultan Haji Ahmad Shah Hospital, HD Unit	≥80%	Tengku Ampuan Jemaah Hospital, HD Unit	≥80%
Sultan Ismail Hospital (Paed), HD Unit	≥80%	Tengku Ampuan Rahimah Hospital, HD Unit	≥80%
Sultan Ismail Hospital, HD Unit	≥80%	Tengku Anis Hospital, HD Unit	≥80%
Sultanah Aminah Hospital, HD Unit	≥80%	Tenom Hospital, HD Unit	≥80%
Sultanah Bahiyah Hospital, HD Unit	≥80%	The Kidney Dialysis Centre, HD unit	≥80%
Sultanah Nur Zahirah Hospital, HD Unit	≥80%	The Penang Community HD Society, HD Unit	≥80%
Sungai Bakap Hospital, HD Unit	≥80%	Thomson Hospital Kota Damansara, HD Unit	≥80%
Sungai Buloh Hospital, HD Unit	≥80%	Timberland Medical Centre, HD Unit	≥80%
Sunway Medical Centre (2), HD Unit	≥80%	Total Kidney Care Haemodialysis, HD Unit	≥80%
Sunway Medical Centre (3), HD Unit	≥80%	TSM-HATTA Dialysis Centre, HD Unit	≥80%
Sunway Medical Centre (4), HD Unit	≥80%	Tuanku Ampuan Najihah Hospital, HD Unit	≥80%
Sunway Medical Centre Sdn Bhd (5), HD Unit	≥80%	Tuanku Fauziah Hospital, HD Unit	≥80%
Sunway Medical Centre Sdn Bhd (6), HD Unit	≥80%	Tuanku Ja'afar Hospital (Paed), HD Unit	≥80%
Sunway Medical Centre Sdn Bhd (7), HD Unit	<80%	Tuanku Ja'afar Hospital, HD Unit	≥80%
Sunway Medical Centre Sdn Bhd (8), HD Unit	≥80%	Tuaran Hospital, HD Unit	≥80%
Sunway Medical Centre Seberang Jaya, HD Unit	≥80%	Tumpat Hospital, HD Unit	≥80%
Superkids Trinity-NKF Dialysis Centre, HD Unit	≥80%	Tung Shin Hospital, HD Unit	≥80%
Suriya Dialysis Centre, HD Unit	NIL	UCSI Hospital, HD Unit	≥80%
Syukur Dialisis (Puchong), HD Unit	≥80%	Unit Dialisis Komuniti Chiku 3, HD Unit	≥80%
Syukur Haemodialysis (Bakri), HD Unit	≥80%	Unit Hemodialisis Hospital Pendang, HD Unit	≥80%
Syukur Haemodialysis (Batu Pahat), HD Unit	≥80%	Unit Hemodialisis Hospital UiTM (Bandar Puncak Alam), HD Unit	≥80%
Syukur Haemodialysis Semerah, HD Unit	≥80%	Unit Hemodialisis Komuntiti Kodiang, HD Unit	≥80%
Taiping Hospital, HD Unit	≥80%	Unit Hemodialisis Lenggong, HD Unit	≥80%
Taiping Medical Centre, HD Unit	≥80%	Unit Hemodialisis Pantai Remis, HD Unit	≥80%
Tambunan Hospital, HD Unit	≥80%	Unit Hemodialisis Sungai Koyan, HD Unit	≥80%
Tampin Hospital, HD Unit	≥80%	Universiti Kebangsaan Malaysia Bangi, HD Unit	≥80%
Tan Sri Muhyiddin Charity Dialysis Centre, HD Unit	≥80%	Universiti Sains Malaysia Hospital, HD Unit	≥80%

PARTICIPATING HAEMODIALYSIS CENTRES 2023 *(Cont.)*

Haemodialysis Centres	AR	Haemodialysis Centres	AR
University Malaya Medical Centre, HD Unit	≥80%	YKN Dialisis (Kuala Pilah), HD Unit	≥80%
University Malaya Specialist Centre, HD Unit	≥80%	YKN Dialisis Kuala Terengganu, HD Unit	≥80%
Woh Peng Cheang Seah, HD Unit	≥80%	YKN Dialisis Rompin, HD Unit	≥80%
Yan Hospital, HD Unit	≥80%	Zaharah Dialisis Center (Jitra), HD Unit	≥80%
Yayasan Kebajikan SSL Puchong, HD Unit	≥80%	Zaharah Dialisis Centre (Pokok Sena), HD Unit	≥80%
Yayasan Kebajikan SSL, HD Unit	≥80%	Zaharah Dialysis Center (Kangar), HD Unit	≥80%
Yayasan Rotary Kluang, HD Unit	≥80%	Zhi En Dialysis Centre, HD Unit	≥80%
YKN Dialisis (Kota Bharu), HD Unit	≥80%		

PARTICIPATING PERITONEAL DIALYSIS CENTRES 2023

Peritoneal Dialysis Centres	AR	Peritoneal Dialysis Centres	AR
96 Hospital Angkatan Tentera (Lumut), CAPD Unit	≥80%	Puteri Specialist Hospital, CAPD Unit	≥80%
Ampang Hospital, CAPD Unit	≥80%	Putrajaya Hospital, CAPD Unit	≥80%
Assunta Hospital, CAPD Unit	≥80%	Queen Elizabeth Hospital, CAPD Unit	≥80%
Avisena Dialysis Centre, CAPD Unit	≥80%	Raja Perempuan Zainab II Hospital, CAPD Unit	≥80%
Bentong Hospital, CAPD Unit	≥80%	Raja Permaisuri Bainun Hospital, CAPD Unit	≥80%
Besut Hospital, CAPD Unit	≥80%	Rembau Hospital, CAPD Unit	NIL
Columbia Asia Hospital (Tebrau), CAPD Unit	NIL	Renal Dialysis Centre, CAPD Unit	<80%
Duchess of Kent Hospital, CAPD Unit	≥80%	Sarawak General Hospital, CAPD Unit	≥80%
Dungun Hospital, CAPD Unit	≥80%	Seberang Jaya Hospital, CAPD Unit	≥80%
Gleneagles Medini, CAPD Unit	NIL	Selayang Hospital (Paed), CAPD Unit	≥80%
Hospital Angkatan Tentera Tuanku Mizan, CAPD Unit	≥80%	Selayang Hospital, CAPD Unit	≥80%
Hospital Pakar Sultanah Fatimah (Muar), CAPD Unit	≥80%	Serdang Hospital, CAPD Unit	≥80%
Hospital Seri Manjung, CAPD Unit	≥80%	Setiu Hospital, CAPD Unit	≥80%
Hospital Sultan Abdul Aziz Shah UPM Serdang, CAPD Unit	NIL	Sibu Hospital, CAPD Unit	≥80%
Hospital Sultanah Nora Ismail, CAPD Unit	≥80%	Sri Kota Medical Centre, CAPD Unit	≥80%
Hospital Tuanku Ampuan Najihah, CAPD Unit	NIL	Sultan Abdul Halim Hospital, CAPD Unit	≥80%
Hospital Tunku Azizah, Kuala Lumpur (Paed), CAPD Unit	≥80%	Sultan Ahmad Shah Medical Centre @ IIUM, CAPD Unit	NIL
Hospital Wanita Dan Kanak-kanak Sabah (Paed), CAPD Unit	≥80%	Sultan Haji Ahmad Shah Hospital, CAPD Unit	≥80%
Hulu Terengganu Hospital, CAPD Unit	≥80%	Sultan Ismail Hospital (Paed), CAPD Unit	≥80%
Johor Specialist Hospital, CAPD Unit	NIL	Sultan Ismail Hospital, CAPD Unit	≥80%
Kajang Hospital, CAPD Unit	≥80%	Sultanah Aminah Hospital, CAPD Unit	≥80%
Kemaman Hospital, CAPD Unit	≥80%	Sultanah Bahiyah Hospital, CAPD Unit	≥80%
Keningau Hospital, CAPD Unit	NIL	Sultanah Nur Zahirah Hospital, CAPD Unit	≥80%
Kuala Lumpur Hospital, CAPD Unit	≥80%	Taiping Hospital, CAPD Unit	≥80%
Kulim Hospital, CAPD Unit	≥80%	Tawau Hospital, CAPD Unit	≥80%
Melaka Hospital, CAPD Unit	≥80%	Teluk Intan Hospital, CAPD Unit	≥80%
Miri Hospital, CAPD Unit	≥80%	Tengku Ampuan Afzan Hospital (Paed), CAPD Unit	≥80%
Pantai Hospital Batu Pahat, CAPD Unit	≥80%	Tengku Ampuan Afzan Hospital, CAPD Unit	≥80%
Pasir Mas Hospital, CAPD Unit	≥80%	Tengku Ampuan Rahimah Hospital, CAPD Unit	≥80%
Port Dickson Hospital, CAPD Unit	NIL	Tuanku Ja'afar Hospital (Paed), CAPD Unit	≥80%
Prince Court Medical Centre, CAPD Unit	≥80%	Tuanku Ja'afar Hospital, CAPD Unit	≥80%
Pulau Pinang Hospital (Paed), CAPD Unit	≥80%	Unit Peritoneal Dialisis Hospital UiTM (Bandar Puncak Alam), CAPD Unit	≥80%
Pulau Pinang Hospital, CAPD Unit	≥80%	Universiti Sains Malaysia Hospital, CAPD Unit	≥80%
Pusat Perubatan Universiti Kebangsaan Malaysia, CAPD Unit	≥80%	University Malaya Medical Centre, CAPD Unit	≥80%
Pusat Perubatan Universiti Teknologi Mara, CAPD Unit	≥80%		

PARTICIPATING RENAL TRANSPLANT FOLLOW-UP CENTRES 2023

Renal Transplant Follow-up Centres	AR	Renal Transplant Follow-up Centres	AR
Assunta Hospital, Tx Unit	≥80%	Raja Permaisuri Bainun Hospital, Tx Unit	≥80%
Bintulu Hospital, Tx Unit	≥80%	Renal Care (Ipoh Specialist), Tx Unit	≥80%
Duchess of Kent Hospital, Tx Unit	≥80%	Sarawak General Hospital, Tx Unit	≥80%
Fan Medical Renal Clinic, Tx Unit	<80%	Segamat Hospital, Tx Unit	≥80%
Hospital Al-Sultan Abdullah UiTM (Bandar Puncak Alam), Tx Unit	<80%	Selayang Hospital, Tx Unit	≥80%
Hospital Enche' Besar Hajjah Khalsom, Tx Unit	≥80%	Serdang Hospital, Tx Unit	≥80%
Hospital Pakar Sultanah Fatimah (Muar), Tx Unit	≥80%	Sibu Hospital, Tx Unit	≥80%
Hospital Seri Manjung, TX Unit	≥80%	Sime Darby Medical Centre Subang Jaya, Tx Unit	<80%
Hospital Sultanah Nora Ismail, Tx Unit	≥80%	Sri Kota Medical Centre, Tx Unit	NIL
Kemaman Hospital, Tx Unit	≥80%	Sultan Abdul Halim Hospital, Tx Unit	≥80%
Klinik Dr Choo & Liew, Tx Unit	≥80%	Sultan Haji Ahmad Shah Hospital, Tx Unit	≥80%
KPJ Ampang Puteri Specialist Hospital, Tx Unit	≥80%	Sultan Ismail Hospital (Paed), Tx Unit	≥80%
KPJ Sabah Specialist Hospital, Tx Unit	NIL	Sultan Ismail Pandan Hospital, Tx Unit	≥80%
Kuala Lumpur Hospital (Paed), Tx Unit	≥80%	Sultanah Aminah Hospital, Tx Unit	≥80%
Kuala Lumpur Hospital, Tx Unit	≥80%	Sultanah Bahiyah Hospital, Tx Unit	≥80%
Kulim Hospital, Tx Unit	≥80%	Sultanah Nur Zahirah Hospital, Tx Unit	≥80%
Labuan Hospital, Tx Unit	≥80%	Sunway Medical Centre, TX Unit	≥80%
Mahkota Medical Centre, Tx Unit	≥80%	Taiping Hospital, Tx Unit	≥80%
Melaka Hospital, Tx Unit	≥80%	Tan Medical Renal Clinic, Tx Unit	<80%
Mersing Hospital, Tx Unit	≥80%	Tawau Hospital, Tx Unit	≥80%
Miri Hospital, Tx Unit	≥80%	Tengku Ampuan Afzan Hospital, Tx Unit	≥80%
Pontian Hospital, Tx Unit	≥80%	Tengku Ampuan Rahimah Hospital, Tx Unit	≥80%
Prince Court Medical Centre, Tx Unit	≥80%	Timberland Medical Centre, Tx Unit	NIL
Pulau Pinang Hospital, Tx Unit	≥80%	Tuanku Ja'afar Hospital, Tx Unit	≥80%
Pusat Perubatan Universiti Kebangsaan Malaysia, Tx Unit	≥80%	Universiti Sains Malaysia Hospital, Tx Unit	NIL
Queen Elizabeth Hospital, Tx Unit	≥80%	University Malaya Medical Centre, Tx Unit	≥80%
Raja Perempuan Zainab II Hospital, Tx Unit	≥80%		

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FOREWORD

Our Malaysian Dialysis and Transplant registry (MDTR) is 33 years old this year, and still going strong thanks to the commitment of many individuals including the Chief Editors (Dr Hooi Lai Seong and Dato Dr Ong Loke Meng), NRR core management team (Mr Choo Cheh Loo and Dr Wan Najdah), members of the NRR Advisory Board and NRR Data Management committee, our statistician, the Information Technology team Altus, Chapter Editors and Authors, and last but not least, the source data providers who have now exceeded the 1000+ mark. We are also immensely grateful for the vital support of the National Kidney Foundation of Malaysia and grants from several industry partners – Fresenius Medical Care, Baxter, Duopharma and Kyowa Kirin.

With staff turnover, new dialysis or transplant centres and new developments in data collection, we need continued commitment from everyone to ensure that the registry data is of high quality. It is essential that care providers who enter data have a good understanding of data requirements. Training workshops for data entry are held annually during the MSN Congress and in addition, both the National Kidney Foundation of Malaysia and University of Malaya have included training sessions with NRR staff in their post-basic renal training curriculae. The importance of Patient-related outcomes (PROMS) is increasingly acknowledged, and assessment of these is planned to be included in future data collection by the registry. In 2024, the MDTR also embarked on the process of data integration with a number of commercial medical databases. Other developments include conducting a pilot study into the feasibility of setting up a Rare Kidney Disease Registry (MaRRKid). It is our sincere hope that the MDTR will continue to improve, and that its full potential, including in terms of research, can be more fully realised in years to come.

Dr Sunita Bavanandan
Chair
Advisory Committee 2024-2026
National Renal Registry

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EXECUTIVE SUMMARY

At the end of 2023, there were 53,210 patients receiving dialysis in Malaysia, with an almost static number of new patients starting kidney replacement therapy (KRT) in the preceding three years, While the new intake of dialysis patients was 10,037 in 2022, this was 10,027 in 2023. The incidence and prevalence of patients on dialysis was 300 and 1594 per million population (pmp) in 2023. Among the incident dialysis patients, 18.2% were on peritoneal dialysis (PD) while 11.8% of the prevalent dialysis patients were on PD.

Patients above 55 years old made up 57.7% of all new dialysis patients and 58.8% of prevalent dialysis patients in 2023. Diabetes mellitus was the primary renal disease in 56.3% of new dialysis patients in 2023.

Although the private, public and NGO sectors provided 55%, 29.1% and 15.9% of dialysis treatment in 2023 respectively, the government provided 83.7% of funding for dialysis. This includes direct funding (47%), SOCSO or social security organisation (24.5%) and Zakat (12.2%). Zakat is a tithe mandatory on all Muslims who have excess income.

The annual death rate on dialysis in 2023 was 14%. In 2023, the death rate was 14% among haemodialysis (HD) patients while PD patients had an annual death rate of 17%. Infections superseded cardiovascular disease as the main cause of death in 2023.

Median serum albumin in HD patients was 38.9 mg/dl, while it was lower at 32.0 in PD patients in 2022. Median body mass index was 25.2 in HD patients and 24.8 in PD patients.

Ninety-three percent of HD patients and 86% of PD patients received erythropoiesis stimulating agents (ESAs) in 2023. Some dialysis patients received blood transfusions (8% HD, 4% PD) which is less compared to 2014 (12% HD and 18% PD). In 2023, the median haemoglobin was 10.3 g/dl in HD patients on ESAs whilst it was 10.1 g/dl in PD patients on ESAs.

In 2023, only 20% of HD patients and 37% of PD patients had a pre-dialysis systolic blood pressure < 140 mmHg. The diastolic BP was better controlled being < 90 mmHg in 85% and 84% of HD and PD patients respectively. The mean and median LDL cholesterol levels in HD patients in 2023 were 2.3 mmol/l and 2.2 mmol/l respectively; it was higher in PD patients, mean 2.7 mmol/l and median 2.6 mmol/l.

The main phosphate binders used in 2023 were calcium based binders (94% HD patients and 90% PD patients). Vitamin D receptor agonists were used in 67% of HD patients and 45% of PD patients in 2023. Calcimimetics were used in 4% HD patients and 2% PD patients in the same year. 0.8% of dialysis patients underwent parathyroidectomy in 2023.

The use of catheters for vascular access has gone up from 16.7% in 2019 to 23.5% in 2023. There was a wide variation in percent vascular access at first HD (Fistula+AVG) of all HD starts by State in Malaysia, 1 January 2023 - 31st December 2023, from 82.3% in the state of Johor to 33% in Kedah. Blood flow rates of $\geq$ 300 ml/min was reported for 59% of HD patients in 2023. Most HD patients were on 3 sessions per week (97.5%) and 98.9% were on 4 hours per session. Most dialysers were from synthetic membranes (83%), and 69.7% were re-used. Median delivered KT/V was 1.5 and median urea reduction ratio (URR) was 71.1%.

In 2023, 21.6% of the total PD population was on automated peritoneal dialysis (APD), 78% on standard CAPD (continuous ambulatory peritoneal dialysis). For CAPD 82.6% were on 4 exchanges per day, and 80.5% were using 8 l/day of total dwell volume. Median KT/V was 1.8; the median peritonitis rate was 0.32 episode/patient year.

The number of new kidney transplants reported was 279, incidence 8 per million population (pmp) and prevalence 63 pmp in 2023. Of these, 249 were performed within Malaysia while 30 were from other countries, 23 being from Cambodia. Twenty-one of the "foreign" transplants were classified as commercial transplants. There were 82 deceased donor transplants, 193 living donor transplants, with 4 being of unknown donor type. Patient survival for the cohort 2014 – 2023 was 97% and 92% at 1- year and 5-years respectively.

Paediatric patients < 18 years old showed an uptake of KRT of 9 per million age-related population with a prevalence rate of 101 pmp. These rates have been static for the last 6 years. At the end of 2023 there were 868 dialysis patients and 139 transplant patients in this age group.

CHAPTER 1

ALL KIDNEY REPLACEMENT THERAPY IN MALAYSIA

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SECTION 1.1: STOCK AND FLOW

The incidence of patients requiring kidney replacement therapy (KRT) continues to rise with 10,027 new patients on KRT overall in 2023 as compared to 7601 patients in 2014. The breakdown in terms of dialysis modalities shows a rise of 5% in utilisation of PD from 13% in 2014 to 18% in 2023 (see Table 1.1.1). The transplant rate per million population has also achieved significant growth, particularly in the last 5 years where it has moved up from 3-4 pmp to 8 pmp by 2023.

In 2023, the number of prevalent patients on KRT has increased to 55,311 of whom 46,659 are on HD, 6551 are on PD and 2101 are kidney transplant recipients (Table 1.1.2).

Table 1.1.1: Stock and flow of New KRT Incidence, Malaysia 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis Patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
New HD Patients	8150	8132	7659	7856	7992	7263	6913	7065	6869	6604
New PD Patients	1877	1905	1692	1564	1434	1231	1133	1007	1137	997
New Transplant Patients	279	213	80	152	160	98	112	91	115	91
New Dialysis Rate, pmp	300	307	285	291	295	269	259	263	264	254
New HD Rate, pmp	244	249	234	243	250	230	222	230	227	221
New PD Rate, pmp	56	58	52	48	45	39	36	33	38	33
New Transplant Rate, pmp	8	7	2	5	5	3	4	3	4	3
New HD, %	79.1	79.3	81.2	82.1	83.4	84.5	84.7	86.5	84.6	85.9
New PD, %	18.2	18.6	17.9	16.3	15	14.3	13.9	12.3	14	13
New Tx, %	2.7	2.1	0.8	1.6	1.7	1.1	1.4	1.1	1.4	1.2

Figure 1.1.1(a): Number of new KRT patients by modality (New Dialysis and New Transplant), Malaysia 1969-2023

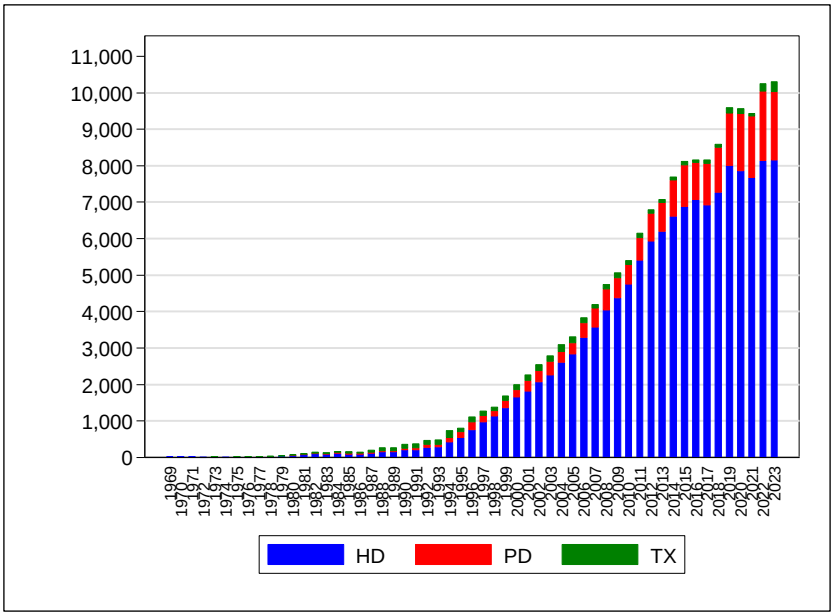


Figure 1.1.1.b provides a historical perspective over the last 5-6 decades in terms of the shifts in proportions of new KRT patients by modality. In the early years of KRT in Malaysia, there was a greater proportion of new transplant in relation to all modalities KRT and this was largely due to limited access to dialysis therapy. PD was introduced in the country in the 1980's and has slowly grown to 18.2% of all KRT in 2022 as compared to 13% in 2013. (Fig 1.1.1b). The proportion of prevalent home dialysis patients has slowly increased to 11.8% in 2023 whereas for many years prior to 2018, the proportion used to remain at ≤10% (Fig 1.1.2b).

Figure 1.1.1(b): Proportion of new KRT patients by modality (New Dialysis and New Transplant), Malaysia 1969-2023

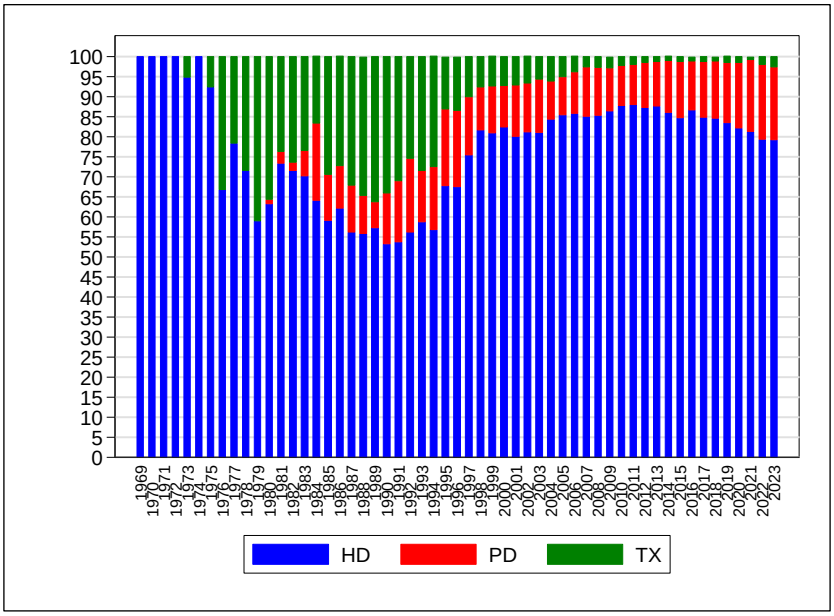


Table 1.1.2: Stock and flow of ESKD Patients on KRT at 31st Dec, Malaysia 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Dialysis Patients	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068
HD Patients	46659	45147	44074	44457	42219	40045	38219	36645	34212	31763
PD Patients	6551	6334	5921	5535	4993	4580	4302	3989	3791	3305
Transplant Patients	2101	1923	1835	1889	1861	1813	1834	1816	1842	1858
Dialysis Rate, pmp	1594.1	1574.4	1525.3	1544.6	1477.7	1415.4	1367	1324.2	1255.4	1174.2
HD Rate, pmp	1397.8	1380.7	1344.7	1373.6	1321.4	1270.1	1228.7	1194.2	1130.2	1063.5
PD Rate, pmp	196.3	193.7	180.6	171	156.3	145.3	138.3	130	125.2	110.7
Transplant Rate, pmp	62.9	58.8	56	58.4	58.2	57.5	59	59.2	60.9	62.2
HD, %	84.4	84.5	85	85.7	86	86.2	86.2	86.3	85.9	86
PD, %	11.8	11.9	11.4	10.7	10.2	9.9	9.7	9.4	9.5	9
Tx, %	3.8	3.6	3.5	3.6	3.8	3.9	4.1	4.3	4.6	5

Figure 1.1.2(a): Prevalence of treated ESKD patients by modality (On KRT at 31st Dec), Malaysia 1969-2023

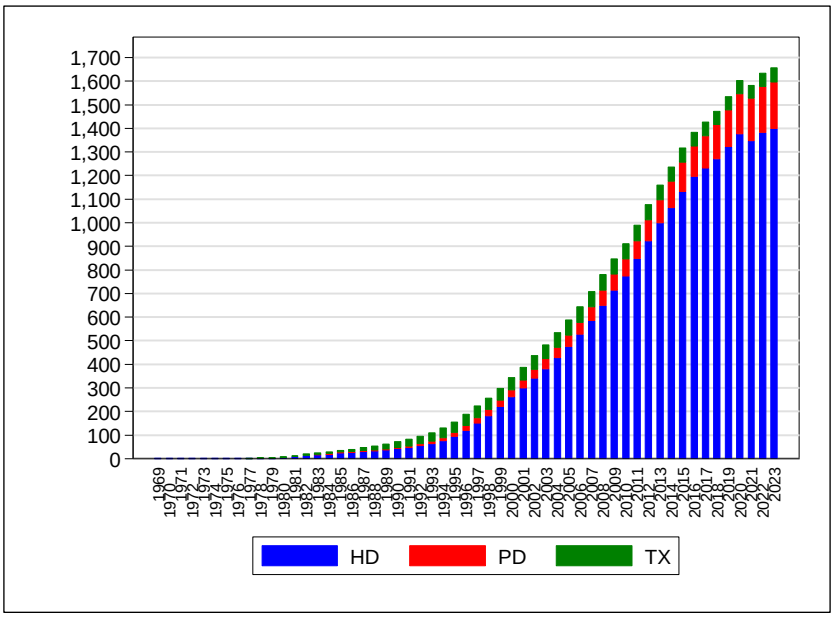
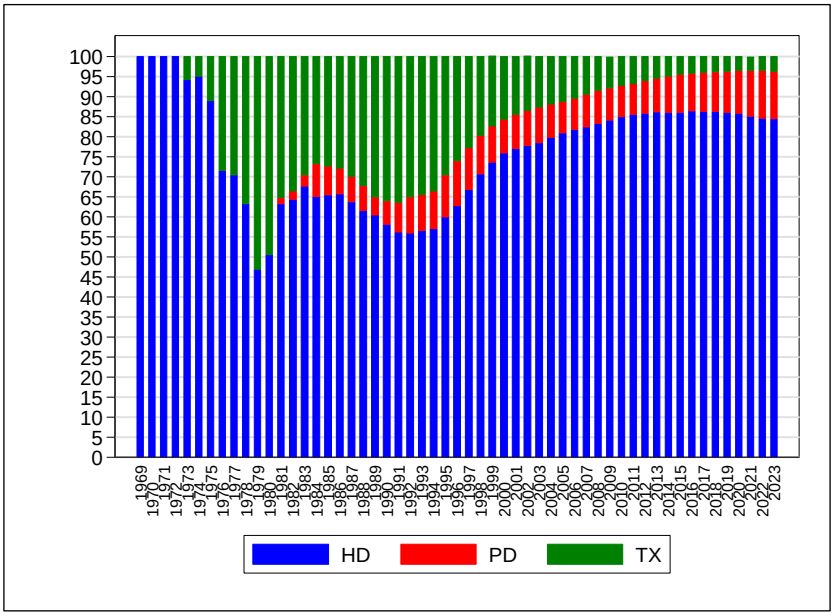


Figure 1.1.2(b): Proportion of treated prevalent ESKD patients by modality (On KRT at 31st Dec), Malaysia 1969-2023



SECTION 1.2: TREATMENT PROVISION RATE

Dialysis acceptance rates are now at 300 pmp as compared with 254 pmp a decade ago (Table 1.1.1). The dialysis prevalence rate increased from 1174 pmp in 2014 to 1594 pmp in 2023, which is a 1.3 fold rise (Table 1.1.2).

The new transplant recipient rate has doubled from 2.6 per 1000 dialysis patients in 2014 to 5.2 per 1000 dialysis patients in 2023. As shown in table 1.2.2 and figure 1.2.3, the transplant rate per 1000 dialysis patients had been declining since the 1990's, reached a nadir in 2016 when the new transplant rate was 2.2 per 1000 dialysis patients, but has shown an uptick in recent years.

Figure 1.2.1: Incidence rate of newly treated ESKD patients (per million population) by modality (New Dialysis and New Transplant), Malaysia 1969-2023

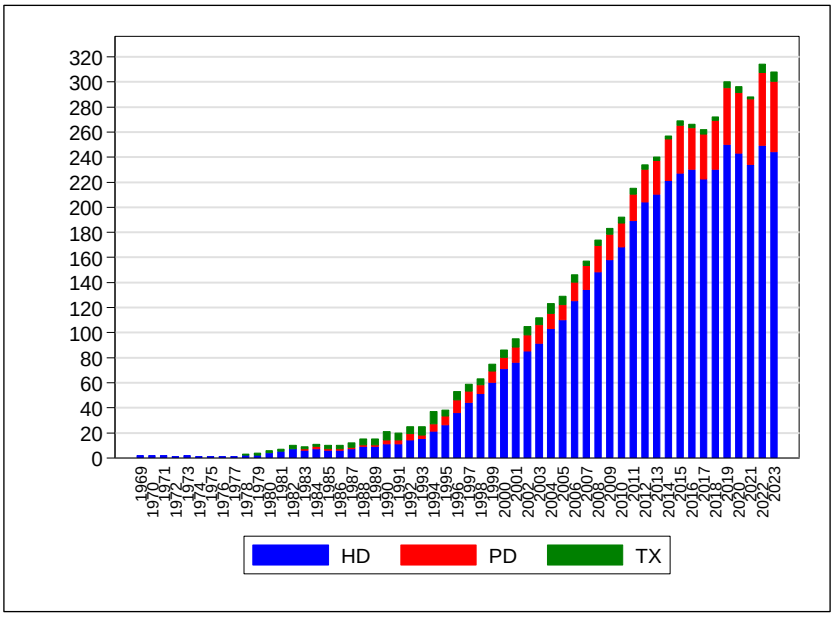


Figure 1.2.2: Prevalence rate of treated ESKD patients (per million population) by modality (On KRT at 31st Dec), Malaysia 1969-2023

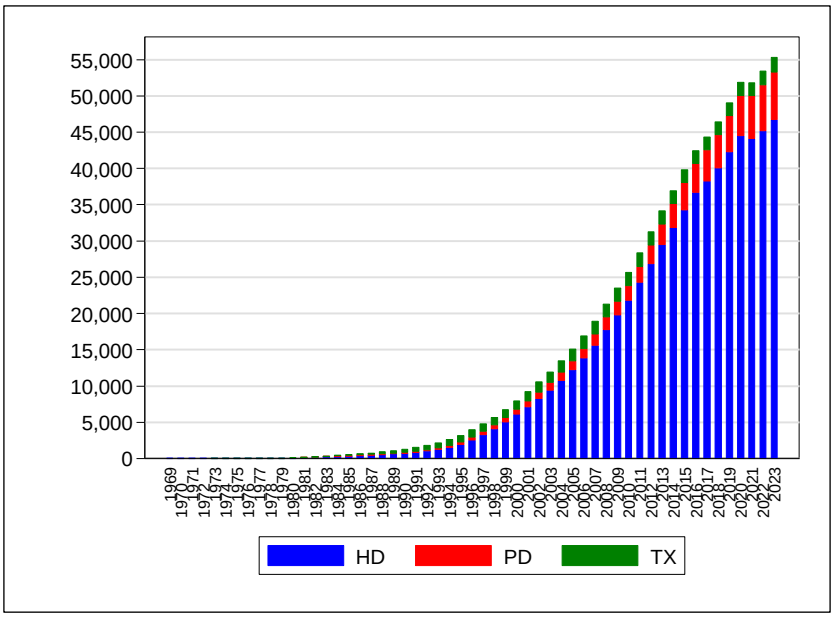
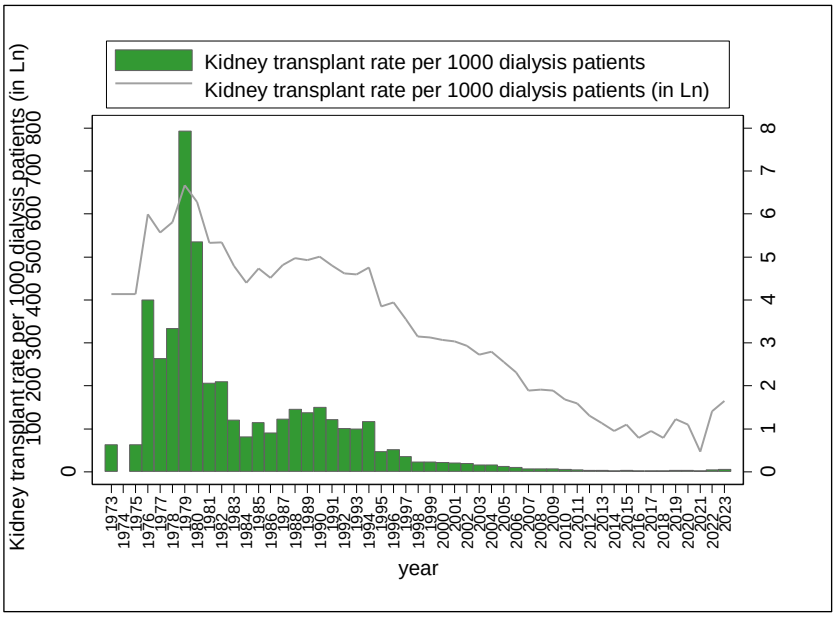


Table 1.2.3: Kidney transplant rate per 1000 dialysis patients, 1969-2023

Year	Number of new transplant recipients	Number of prevalent dialysis patients	Kidney transplant rate per 1000 dialysis patients	Year	Number of new transplant recipients	Number of prevalent dialysis patients	Kidney transplant rate per 1000 dialysis patients
2023	279	53210	5.2	1995	105	2237	46.9
2022	213	51481	4.1	1994	203	1744	116.4
2021	80	49995	1.6	1993	139	1396	99.6
2020	152	49992	3	1992	119	1176	101.2
2019	160	47212	3.4	1991	117	965	121.2
2018	98	44625	2.2	1990	125	831	150.4
2017	112	42521	2.6	1989	96	697	137.7
2016	91	40634	2.2	1988	91	628	144.9
2015	115	38003	3	1987	66	538	122.7
2014	91	35068	2.6	1986	42	462	90.9
2013	100	32273	3.1	1985	46	403	114.1
2012	108	29372	3.7	1984	27	331	81.6
2011	130	26421	4.9	1983	30	249	120.5
2010	128	23788	5.4	1982	40	191	209.4
2009	142	21643	6.6	1981	25	121	206.6
2008	133	19436	6.8	1980	30	56	535.7
2007	113	17125	6.6	1979	23	29	793.1
2006	153	15110	10.1	1978	8	24	333.3
2005	173	13375	12.9	1977	5	19	263.2
2004	194	11861	16.4	1976	6	15	400
2003	160	10428	15.3	1975	1	16	62.5
2002	172	9123	18.9	1974	0	19	0
2001	163	7851	20.8	1973	1	16	62.5
2000	145	6712	21.6	1972	0	17	0
1999	127	5558	22.8	1971	0	15	0
1998	106	4553	23.3	1970	0	18	0
1997	129	3710	34.8	1969	0	12	0
1996	151	2927	51.6				

Figure 1.2.3: Kidney transplant rate per 1000 dialysis patients, Malaysia 1969 – 2023



SECTION 1.3: HIV POSITIVE PATIENTS ON KRT

There is a small number of HIV positive patients on KRT, i.e. 112 in total, with 53% on PD and 45% on HD. Most of the HIV positive patients i.e., 91% are managed in Ministry of Health (MOH) facilities. Of the 3 HIV positive transplant patients, one was the first local living donor kidney transplant (LKT) for a HIV positive patient done in University of Malaya Medical Centre in 2022, one was a local LKT who seroconverted post-transplant in 2023, and one was a LKT done in India in 2018.

Table 1.3.1: Prevalent HIV positive patients in the KRT population, 2023

	Haemodialysis		Peritoneal dialysis		Kidney transplant		Total	
	n	%	n	%	n	%	n	%
MOH	47	94.0	53	89.8	2	66.7	102	91.1
NGO	1	2.0	0	0.0	0	0.0	1	0.9
UNIVERSITY	2	4.0	6	10.2	1	33.3	9	8.0
Total	50	100	59	100	3	100	112	100

NGO = Non-governmental organisation
HIV = human immunodeficiency virus

CHAPTER 2

DIALYSIS IN MALAYSIA

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SECTION 2.1: PROVISION OF DIALYSIS IN MALAYSIA

2.1.1: Dialysis treatment provision

Table 2.1.1: Stock and flow - Dialysis Patients, Malaysia 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
Died	7527	8034	9091	6359	6495	6153	5949	5402	5003	4728
Transplanted	238	179	60	139	130	81	101	71	99	90
Lost to Follow-up	45	37	33	35	38	57	39	32	35	46
Dialysing at 31st December	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068

Table 2.1.1(a): Stock and flow - HD Patients, Malaysia 2014-2023

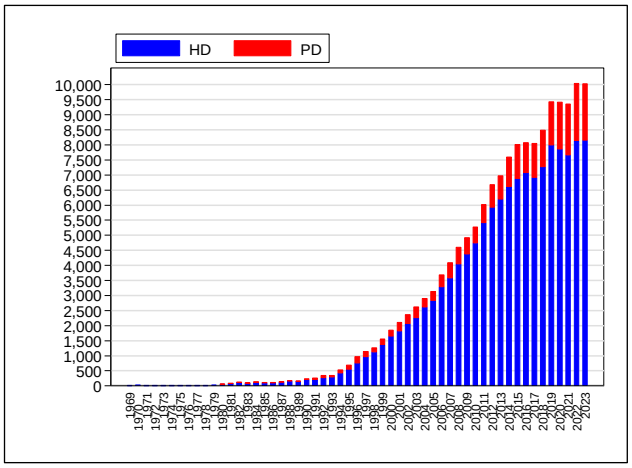
Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	8150	8132	7659	7856	7992	7263	6913	7065	6869	6604
Died	6419	6850	7922	5477	5602	5334	5174	4671	4372	4152
Transplanted	195	147	52	112	103	56	93	65	89	76
Lost to Follow-up	38	34	26	32	35	50	37	30	34	45
Dialysing at 31st December	46659	45147	44074	44457	42219	40045	38219	36645	34212	31763

Table 2.1.1(b): Stock and flow - PD Patients, Malaysia 2014-2023

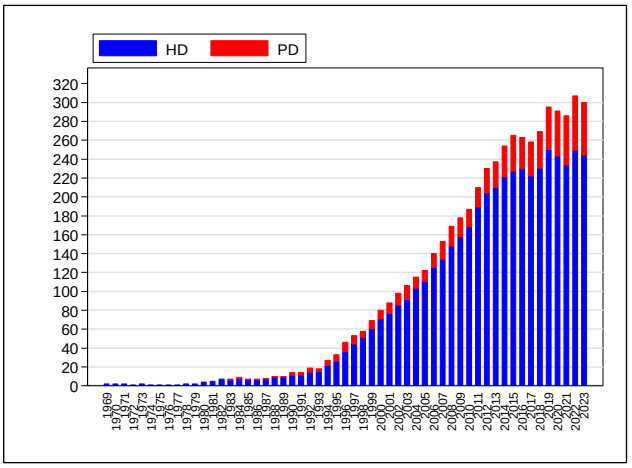
Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	1877	1905	1692	1564	1434	1231	1133	1007	1137	997
Died	1108	1184	1169	882	893	819	775	731	631	576
Transplanted	43	32	8	27	27	25	8	6	10	14
Lost to Follow-up	7	3	7	3	3	7	2	2	1	1
Dialysing at 31st December	6551	6334	5921	5535	4993	4580	4302	3989	3791	3305

Figure 2.1.1: New Dialysis (Haemodialysis & Chronic PD) Incidence Rate per Million Population, Malaysia 1969-2023

(a) Number of New Dialysis Incidence, Malaysia 1969-2023



(b) New Dialysis Incidence Rates, Malaysia 1969-2023



2.1.2: Geographic distribution

There was a total of 10,027 new dialysis patients in 2023 comprising 8,150 new HD and 1,877 new PD patients. Eight states recorded an AR of between 300 to 399, 4 states had an AR of between 200 to 299 pmp and 2 states reported an AR of less than 200 pmp. The state with the highest AR was Melaka (384 pmp) followed by WP Kuala Lumpur (376 pmp), Kedah (375 pmp), Negeri Sembilan (372 pmp) and Terengganu (351 pmp). Sabah remains the state with the lowest acceptance rate (159 pmp) followed by Perlis (191 pmp), Sarawak (273 pmp), Selangor (274 pmp) and Kelantan (282 pmp). Among the states with lowest acceptance rate, the rate has been increasing over the years. In general, the west coast states of Peninsular Malaysia had higher AR compared with the east coast states of Peninsular Malaysia followed by East Malaysian states.

Table 2.1.2(a): Dialysis Treatment and Rate by Centre state, per million population 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Johor	332	352	336	340	354	326	334	337	305	327
Kedah	375	306	347	306	319	300	286	286	267	278
Kelantan	282	251	210	245	235	208	179	216	213	136
Melaka	384	456	394	367	372	349	302	307	330	327
Negeri Sembilan	372	370	394	356	407	389	366	376	344	357
Pahang	292	333	311	270	281	235	226	230	253	245
Perak	341	407	374	420	396	325	296	284	349	284
Perlis	191	214	146	162	185	233	183	159	177	204
Pulau Pinang	338	371	351	370	353	316	326	355	311	331
Sabah WP Labuan	159	157	143	131	140	113	114	129	113	99
Sarawak	273	302	254	249	221	176	194	173	182	177
Selangor	274	262	238	252	271	258	225	230	257	250
Terengganu	351	365	371	382	347	323	281	286	267	277
WP Kuala Lumpur	376	355	325	348	344	343	371	356	345	325

2.1.3: Gender distribution

The acceptance rate for males has remained higher compared with females. However, over the last decade there has been a modest trend toward narrowing of the gap. The difference in treatment rate has narrowed from 41ppm in 2014 to 19ppm in 2023 while the ratio of males:females has narrowed from 1.16 in 2014 to 1.06 in 2023.

Table 2.1.3(a): Dialysis Treatment Rate by Gender, per million male or female population 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Dialysis										
Male	310	322	294	298	310	278	265	272	279	267
Female	289	291	279	282	268	246	237	238	233	227
HD										
Male	252	261	240	249	263	239	229	240	243	234
Female	235	235	230	235	228	208	202	206	196	195
PD										
Male	58	61	54	49	47	38	36	32	36	33
Female	54	56	49	47	41	38	35	32	37	32

Figure 2.1.3(a) (i): Dialysis Treatment Rate by Gender 1969-2023

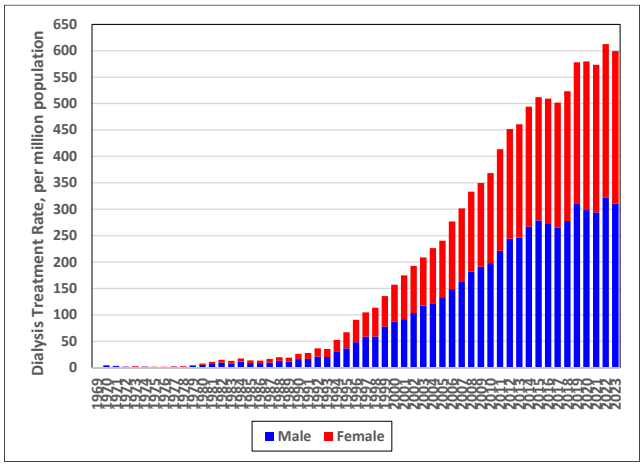


Figure 2.1.3(a) (ii): HD Treatment Rate by Gender 1969-2023

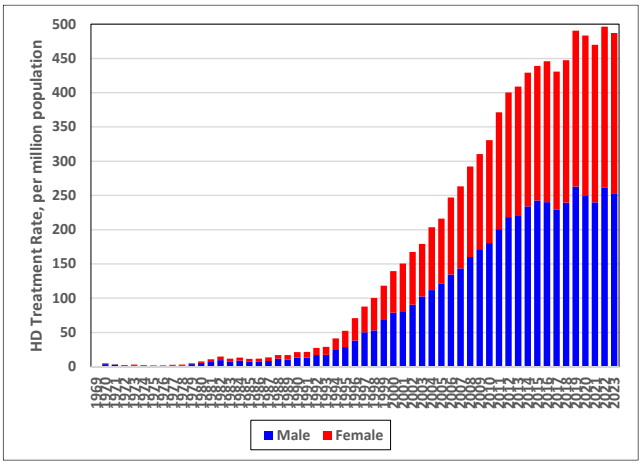


Figure 2.1.3(a) (iii): PD Treatment Rate by Gender 1969-2023

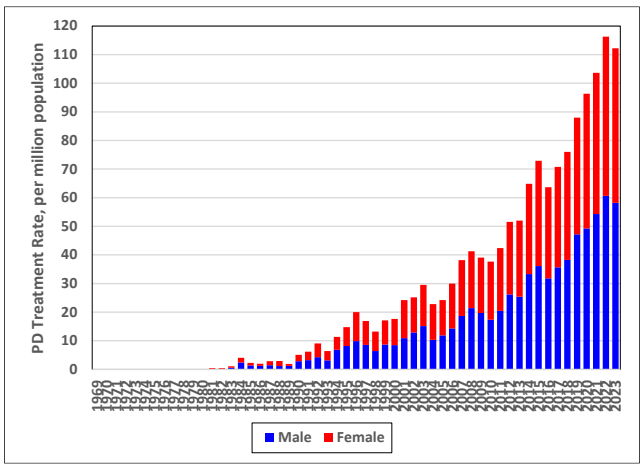
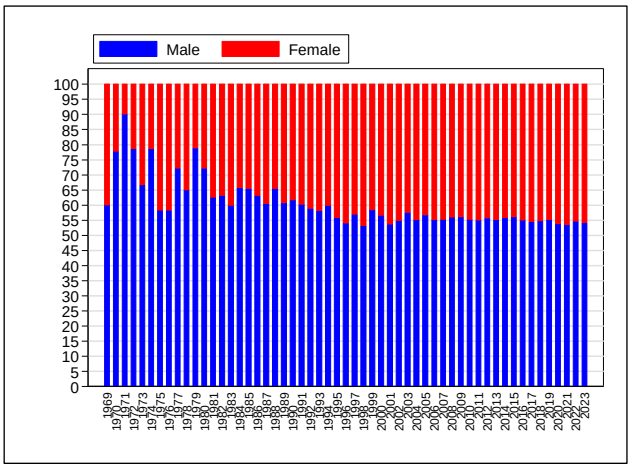


Table 2.1.3(b): Gender Distribution of Dialysis Patients 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
% Male	54.1	54.6	53.5	53.7	55.1	54.7	54.5	55	56.1	55.8
% Female	45.9	45.4	46.5	46.3	44.9	45.3	45.5	45	43.9	44.2
ESKD patients at 31st December	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068
% Male	52.5	52.7	52.8	53.2	53.8	53.9	54.2	54.5	54.5	54.6
% Female	47.5	47.3	47.2	46.8	46.2	46.1	45.8	45.5	45.5	45.4
New HD patients	8150	8132	7659	7856	7992	7263	6913	7065	6869	6604
% Male	54	54.7	53.2	53.8	55.1	55.1	54.9	55.5	56.9	56.2
% Female	46	45.3	46.8	46.2	44.9	44.9	45.1	44.5	43.1	43.8
HD patients at 31st December	46659	45147	44074	44457	42219	40045	38219	36645	34212	31763
% Male	52.7	52.9	53.1	53.5	54.1	54.4	54.7	55.1	55.2	55.1
% Female	47.3	47.1	46.9	46.5	45.9	45.6	45.3	44.9	44.8	44.9
New PD patients	1877	1905	1692	1564	1434	1231	1133	1007	1137	997
% Male	54.2	54.2	54.6	53.5	55.2	52	52.1	51.6	51.2	53
% Female	45.8	45.8	45.4	46.5	44.8	48	47.9	48.4	48.8	47
PD patients at 31st December	6551	6334	5921	5535	4993	4580	4302	3989	3791	3305
% Male	51.4	50.8	50.7	50.7	50.9	49.8	50	49.5	48.9	49.4
% Female	48.6	49.2	49.3	49.3	49.1	50.2	50	50.5	51.1	50.6

Figure 2.1.3(b) (i): Gender Distribution of Dialysis Patients 1969-2023

(i) New Dialysis patients



(ii) ESKD Patients at 31st December

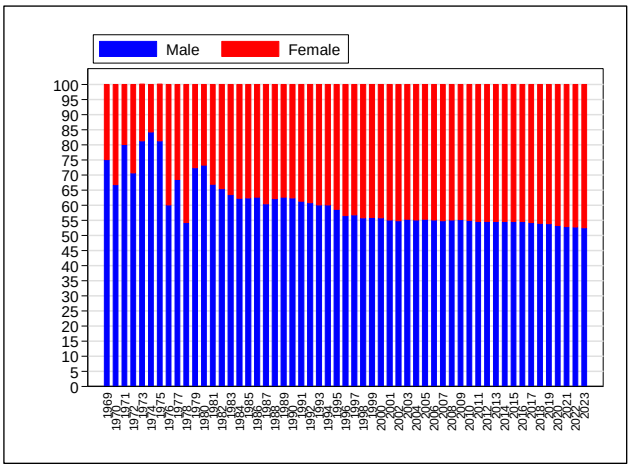
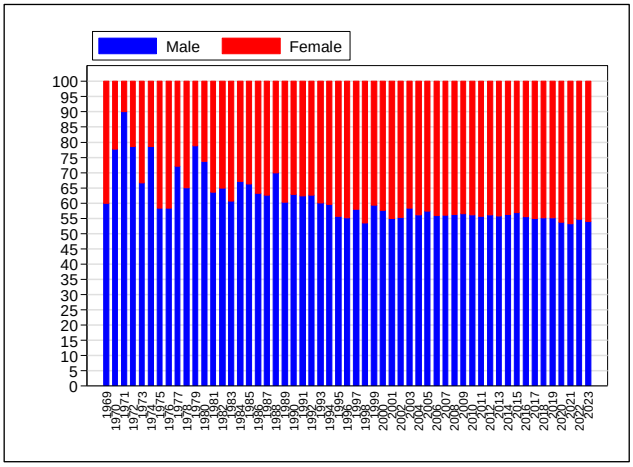


Figure 2.1.3(b) (ii): Gender Distribution of HD Patients 1969-2023

(i) New HD patients



(ii) HD Patients at 31st December

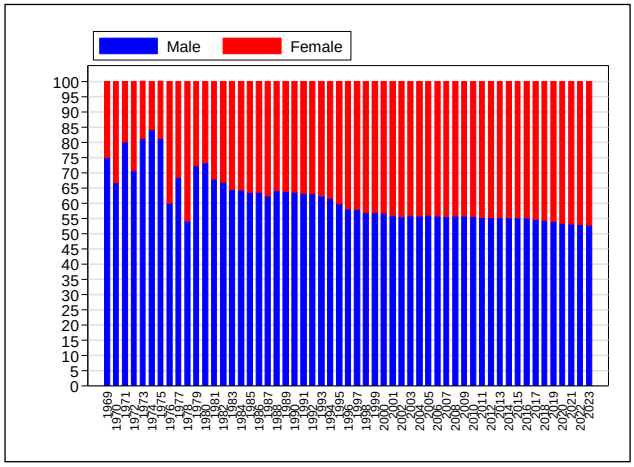
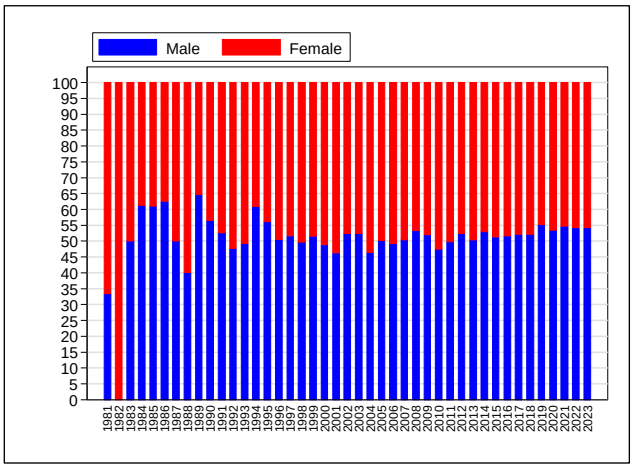
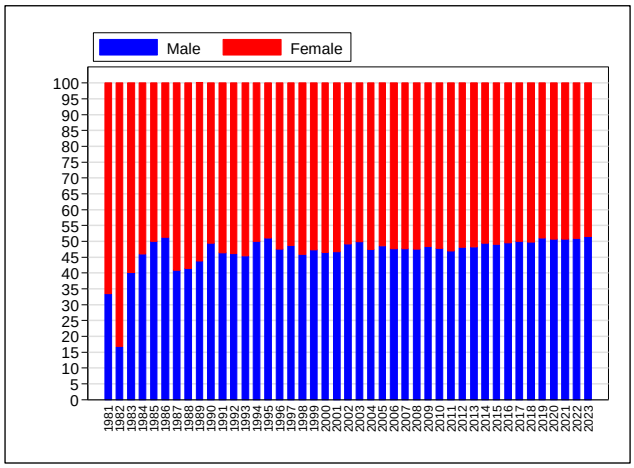


Figure 2.1.3(b) (iii): Gender Distribution of PD Patients 1969-2023

(i) New PD patients



(ii) PD Patients at 31st December



2.1.4: Age distribution

As can be expected, the treatment rate is age dependent with the highest incidence among the elderly (Figure 2.1.4a). The mean and median age have not changed substantially over the last 10 years. The mean age of patients on PD is 5 years younger than HD (Table 2.1.4(a)).

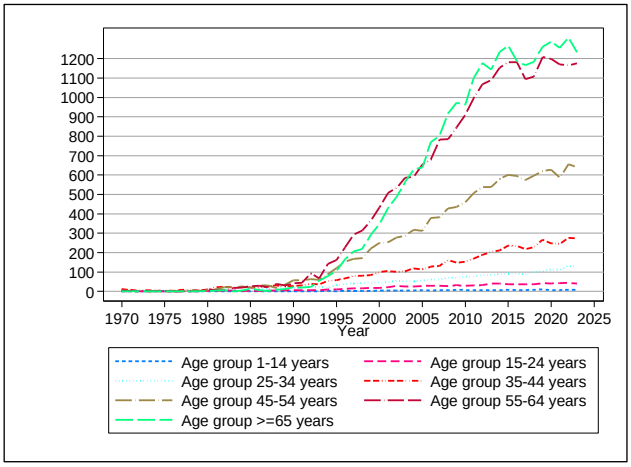
Table 2.1.4(a): Dialysis Treatment Rate by Age Group, per million age group population 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
≤14	9	8	7	7	10	8	7	7	8	6
15-24	40	44	43	41	42	37	36	37	37	40
25-34	125	132	112	114	103	101	87	92	91	88
35-44	274	275	245	248	267	228	218	234	236	211
45-54	641	655	587	628	620	597	574	595	600	580
55-64	1176	1165	1171	1199	1209	1108	1095	1182	1182	1153
≥ 65	1232	1308	1256	1287	1262	1184	1166	1187	1267	1234
Overall Mean age (yrs)	55.1	55.2	55.4	55.4	55.2	55.2	55.4	55.1	55.2	55.1
Overall SD age	14.2	14.4	14.3	14.1	14.3	14.3	14.1	14.1	14.2	14.2
Overall Median age (yrs)	57	57	58	57	57	57	57	57	57	57
HD										
≤14	2	3	2	2	4	2	3	4	2	3
15-24	22	26	24	23	26	25	23	25	24	29
25-34	88	91	76	81	79	77	65	71	70	69
35-44	212	206	185	196	215	187	176	194	196	179
45-54	514	519	474	522	521	501	487	511	504	502
55-64	949	943	959	992	1007	943	943	1030	1013	972
≥ 65	1055	1108	1063	1098	1103	1038	1012	1042	1068	1058
HD Mean age (yrs)	56.2	56.3	56.5	56.3	56.1	56	56.2	55.7	55.8	55.5
HD SD age	13.7	13.8	13.5	13.5	13.7	13.7	13.4	13.6	13.5	13.8
HD Median age (yrs)	58	58	58	58	58	58	58	57	57	57
PD										
≤14	6	5	5	5	7	5	5	3	5	3
15-24	18	18	18	19	16	12	13	12	13	11
25-34	37	41	36	33	24	24	22	22	21	18
35-44	62	69	60	52	51	41	42	40	40	31
45-54	127	136	112	106	99	96	87	84	96	78
55-64	228	222	212	207	202	165	152	152	169	181
≥ 65	177	200	193	189	158	146	154	145	198	176
PD Mean age (yrs)	51.1	51	51.1	51.3	51.1	51.3	51	51.4	52.1	52.9
PD SD age	15.8	15.7	16.2	16	16.3	16.2	16.5	16.1	16.8	15.8
PD Median age (yrs)	54	53	54	55	55	54	54	54	55	56

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Dialysis patients at 31st December	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068
≤14	24	23	23	22	24	22	21	20	20	19
15-24	155	161	160	162	147	142	144	142	139	137
25-34	554	569	548	534	489	468	450	442	431	414
35-44	1288	1282	1236	1219	1248	1178	1145	1123	1059	993
45-54	2958	2935	2843	2915	2797	2729	2675	2637	2539	2429
55-64	5587	5587	5656	5871	5582	5403	5369	5283	5091	4802
≥ 65	6390	6381	6358	6593	6130	5982	5802	5713	5544	5317
Overall Mean age (yrs)	56.5	56.4	56.4	56.5	56.4	56.3	56.1	56.0	55.8	55.7
Overall SD age	14.0	14.1	14.1	14.0	14.0	14.0	14.0	14.0	14.0	14.1
Overall Median age (yrs)	58.3	58.2	58.3	58.3	58.2	58.0	57.8	57.5	57.4	57.2
HD patients at 31st December	46659	45147	44074	44457	42219	40045	38219	36645	34212	31763
≤14	6	6	7	8	9	9	8	7	7	6
15-24	93	99	98	101	95	94	98	97	97	97
25-34	427	438	427	430	400	384	369	370	364	355
35-44	1090	1090	1062	1064	1097	1038	1013	1001	950	895
45-54	2608	2580	2524	2617	2520	2464	2423	2394	2307	2227
55-64	4979	4999	5070	5280	5054	4930	4924	4857	4657	4403
≥ 65	5861	5842	5832	6074	5664	5525	5342	5267	5088	4918
HD Mean age (yrs)	57.3	57.2	57.2	57.2	57.0	56.9	56.7	56.5	56.4	56.2
HD SD age	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.6
HD Median age (yrs)	58.9	58.8	58.8	58.8	58.6	58.4	58.2	57.9	57.7	57.5
PD patients at 31st December	6551	6334	5921	5535	4993	4580	4302	3989	3791	3305
≤14	18	17	16	14	15	13	13	13	14	13
15-24	62	63	61	61	52	48	46	45	42	40
25-34	127	131	120	105	89	84	81	72	67	59
35-44	198	192	174	155	151	139	132	122	109	98
45-54	350	355	319	299	276	265	252	243	233	202
55-64	608	588	586	591	528	473	446	426	433	400
≥ 65	529	539	526	519	466	456	460	446	456	400
PD Mean age (yrs)	50.7	50.5	50.6	51.0	50.9	51.0	50.8	50.8	51.1	50.8
PD SD age	16.1	16.3	16.4	16.4	16.6	16.7	16.8	16.9	17.1	17.1
PD Median age (yrs)	53.1	52.9	53.5	54.3	54.2	54.0	53.8	53.8	54.2	54.2

Figure 2.1.4(a) (i): Dialysis Treatment Rate by Age Group 1969-2023

(i) New Dialysis Patients



(ii) Dialysis Patients at 31st December

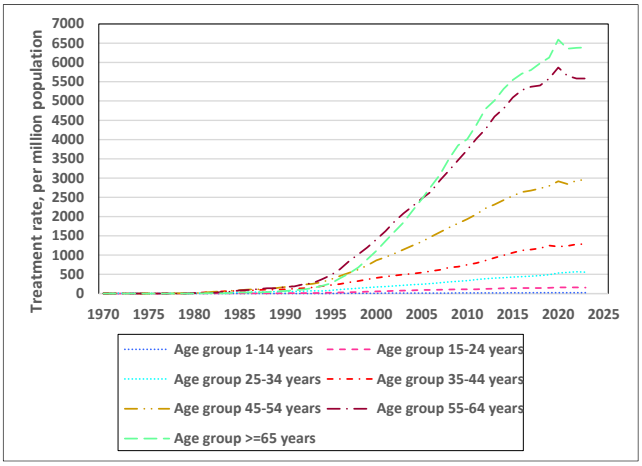
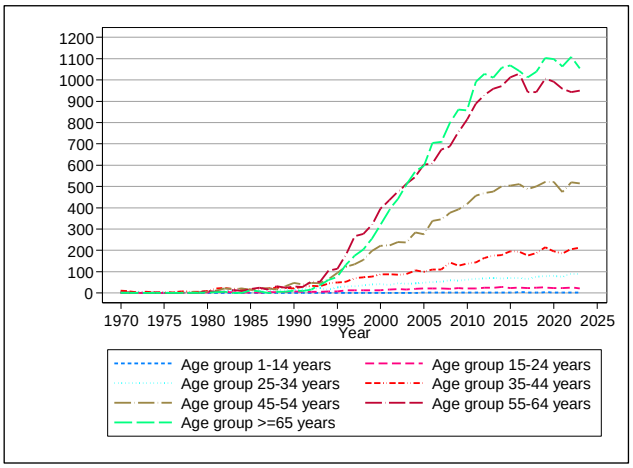


Figure 2.1.4(a) (ii): HD Treatment Rate by Age Group 1969-2023

(i) New HD Patients



(ii) HD Patients at 31st December

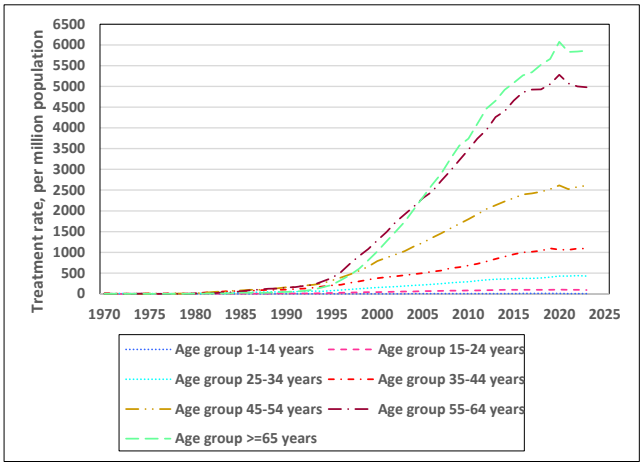
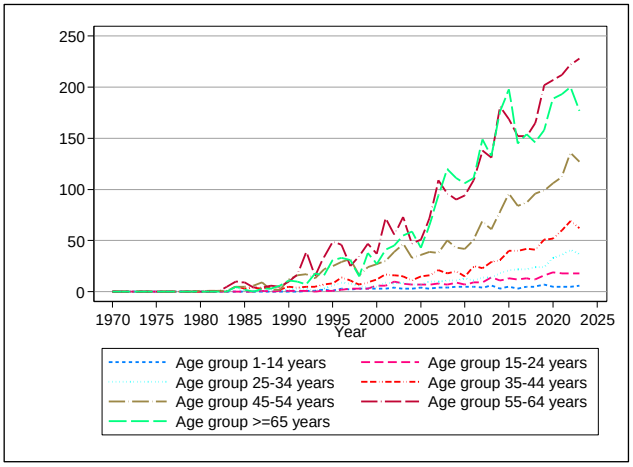


Figure 2.1.4(a) (iii): PD Treatment Rate by Age Group 1969-2023

(i) New PD Patients



(ii) PD Patients at 31st December

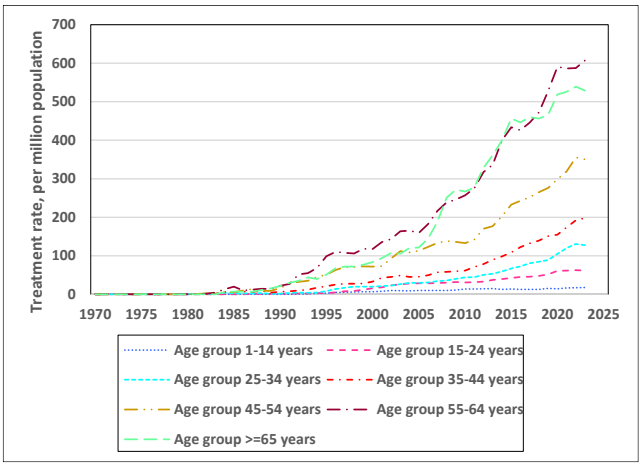
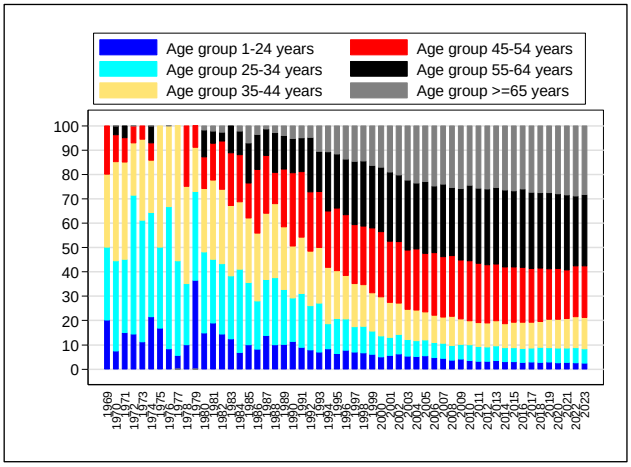


Table 2.1.4(b): Percentage Age Distribution of Dialysis Patients 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
% ≤24	2.4	2.5	2.7	2.5	2.9	2.7	2.8	2.7	3	3
% 25-34	5.9	6.3	5.9	6.1	5.9	6.2	5.8	5.7	5.7	5.7
% 35-44	12.9	12.6	12.1	11.7	11.5	10.6	10.6	10.7	10.5	9.8
% 45-54	21.1	20.9	19.9	20.9	20.8	21.9	22.1	22.6	22.6	23.3
% 55-64	29.4	28.8	30.9	30.8	31.3	31	31.3	32.2	31.4	31.6
% ≥ 65	28.3	28.9	28.5	28	27.6	27.6	27.4	26.1	26.8	26.6
New HD patients	8150	8132	7659	7856	7992	7263	6913	7070	6872	6609
% ≤24	1.3	1.5	1.5	1.3	1.7	1.8	1.7	1.9	1.9	2.5
% 25-34	5	5.3	4.8	5.1	5.2	5.5	5.2	5.1	5.2	5.4
% 35-44	12.3	11.8	11.3	11.3	11.1	10.3	10.1	10.5	10.4	9.8
% 45-54	21	20.8	19.9	21.4	21	22.1	22.4	22.8	22.8	23.6
% 55-64	30	29.6	31.9	31.4	31.7	31.5	32.3	32.8	32.4	31.7
% ≥ 65	30.4	31	30.6	29.5	29.3	28.8	28.3	26.9	27.3	27
New PD patients	1877	1905	1692	1564	1434	1231	1133	1007	1137	997
% ≤24	7.5	6.8	7.7	8.2	9.6	8	9.7	8.6	9.3	7.1
% 25-34	9.8	10.6	10.8	11.3	9.4	10.2	9.7	10	8.7	7.9
% 35-44	15.4	16	15.5	13.6	13.7	12.3	13.5	11.8	10.7	9.6
% 45-54	21.3	21.4	19.9	18.7	19.9	21.2	20.3	21.2	21.3	21.3
% 55-64	26.9	25.3	26	27.5	29.1	27.9	25.3	27.6	25.3	31.1
% ≥ 65	19.1	19.9	20.1	20.7	18.3	20.4	21.5	20.8	24.7	23
Dialysis patients at 31st December	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068
% ≤24	2.0	2.1	2.2	2.2	2.3	2.3	2.4	2.5	2.6	2.8
% 25-34	6.1	6.3	6.3	6.2	6.4	6.4	6.4	6.5	6.7	6.8
% 35-44	12.9	12.8	12.5	12.0	11.9	11.6	11.5	11.5	11.3	11.3
% 45-54	20.2	20.1	19.8	20.0	20.1	20.7	21.1	21.6	22.0	22.5
% 55-64	29.0	29.4	30.2	30.7	30.9	30.9	31.2	31.0	30.9	30.4
% ≥ 65	29.8	29.3	29.1	28.9	28.4	28.1	27.3	26.9	26.6	26.3
HD patients at 31st December	46659	45147	44074	44457	42219	40045	38219	36645	34212	31763
% ≤24	1.3	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.9	2.0
% 25-34	5.3	5.5	5.5	5.6	5.8	5.9	5.9	6.0	6.2	6.4
% 35-44	12.4	12.4	12.2	11.8	11.7	11.4	11.3	11.3	11.3	11.2
% 45-54	20.3	20.2	19.9	20.2	20.3	20.8	21.3	21.7	22.2	22.7
% 55-64	29.5	30.0	30.7	31.0	31.3	31.4	31.8	31.6	31.4	30.8
% ≥ 65	31.2	30.6	30.3	29.9	29.4	28.9	28.0	27.5	27.1	26.8
PD patients at 31st December	6551	6334	5921	5535	4993	4580	4302	3989	3791	3305
% ≤24	7.5	7.7	8.0	8.3	8.6	8.5	8.8	9.3	9.5	10.2
% 25-34	11.3	11.7	11.6	11.0	10.9	11.3	11.4	10.9	10.4	10.3
% 35-44	16.1	15.6	14.8	13.8	13.5	13.4	13.1	12.7	11.6	11.8
% 45-54	19.4	19.8	18.7	18.5	18.8	19.6	19.7	20.3	20.2	19.9
% 55-64	25.6	25.1	26.4	27.9	27.6	26.3	25.6	25.5	26.4	26.9
% ≥ 65	20.1	20.1	20.4	20.5	20.4	20.9	21.4	21.4	21.9	21.0

Figure 2.1.4(b) (i): Age Distribution of Dialysis Patients 1969-2023

(i) New Dialysis Patients



(ii) Dialysis Patients at 31st December

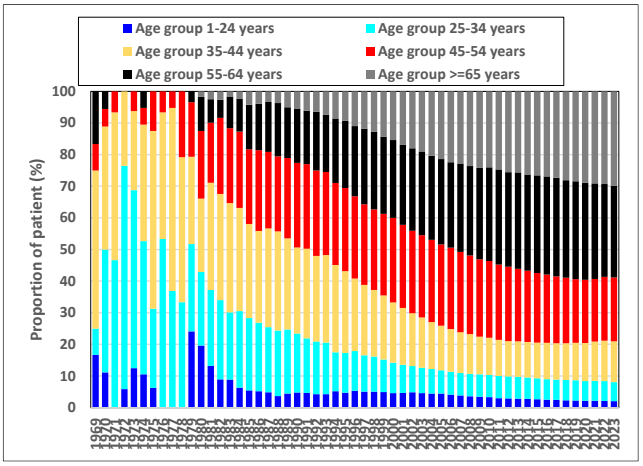
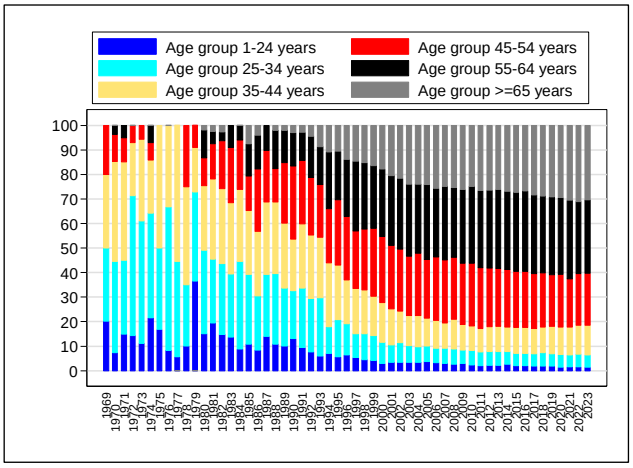


Figure 2.1.4(b) (ii): Age Distribution of HD Patients 1969-2023

(i) New HD patients



(ii) HD Patients at 31st December

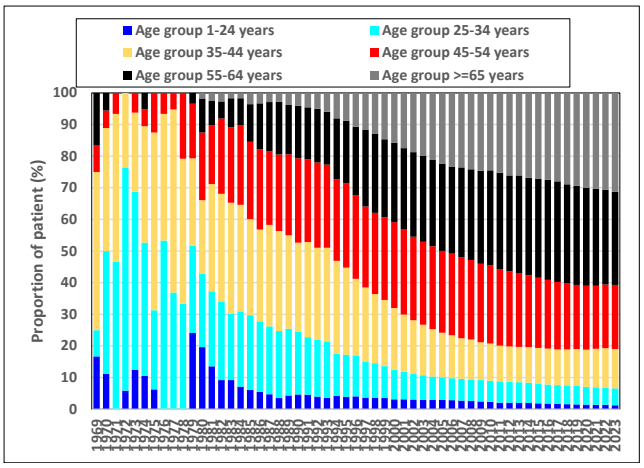
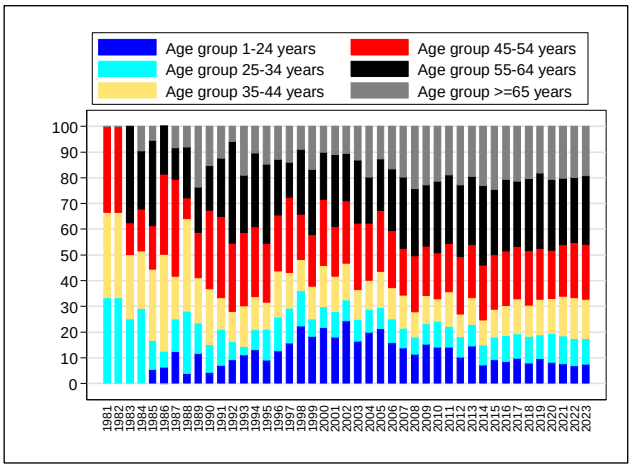
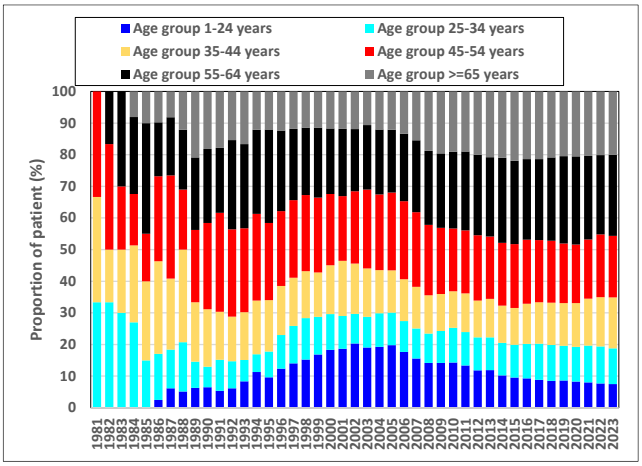


Figure 2.1.4(b) (iii): Age Distribution of PD Patients 1969-2023

(i) New PD Patients



(ii) PD Patients at 31st December



2.1.5: Method and Location of Dialysis

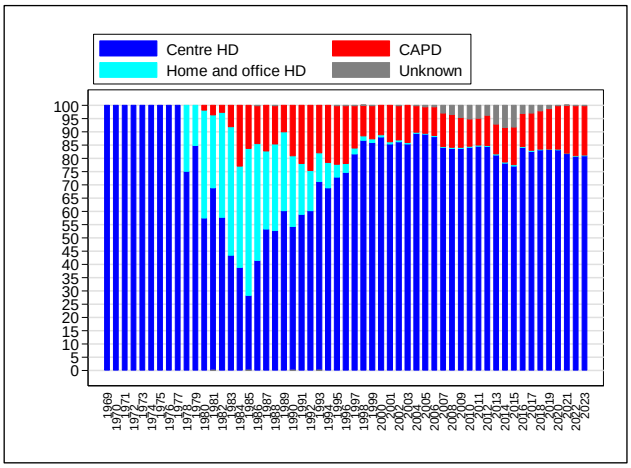
Centre HD continues to dominate over other methods and location of dialysis accounting for 81% and 86% for new and prevalent dialysis patients respectively in 2023. Despite an encouraging trend of an increase in new PD patients for the last 5 years, the prevalent PD patients has remained low (12%). The percentage of incidence patients on home dialysis (both PD and HD) was 18.8% in 2023.

Table 2.1.5: Method and Location of Dialysis Patients 2014-2023

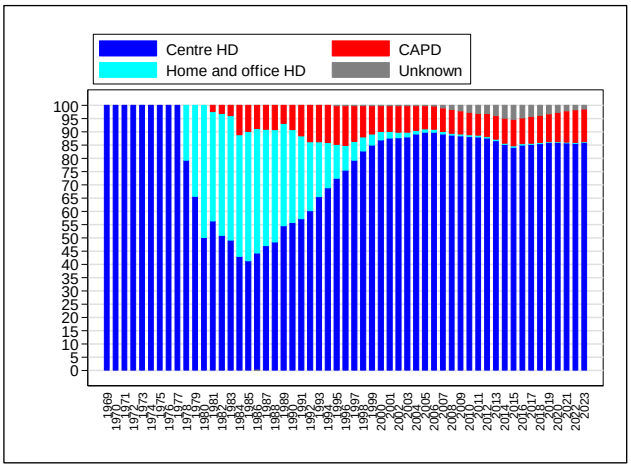
Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
% Centre HD	81	80.7	81.8	83.2	83.3	83.2	82.5	84.1	77	78.1
% Home and office HD	0.1	0.2	0.1	0.1	0.1	0.1	0.4	0.3	0.5	0.4
% PD	18.7	19	18.1	16.6	15.2	14.5	14.1	12.5	14.2	13.1
% Unknown	0.2	0.1	0.1	0.1	1.4	2.2	3.0	3.1	8.3	8.4
ESKD patients at 31st December	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068
% Centre HD	86	85.7	85.7	85.9	85.8	85.5	85.1	84.9	84.1	85.1
% Home and office HD	0.2	0.2	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.5
% PD	12.3	12.3	11.8	11.1	10.6	10.3	10.1	9.8	10	9.4
% Unknown	1.5	1.8	2.2	2.7	3.3	3.8	4.3	4.8	5.4	5.0

Figure 2.1.5: Method and Location of Dialysis Patients 1969-2023

(i) New Dialysis Patients



(ii) ESKD Patients at 31st December



2.1.6: Funding for dialysis treatment

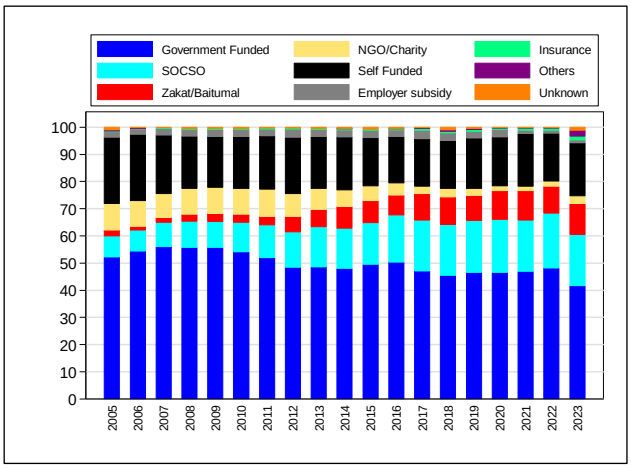
The government continued to be the main source of funding for dialysis therapy for new and existing patients in this country. These funds were channelled not only to the government dialysis centres, but also as subsidies to NGO centres and payment of dialysis treatment for public pensioners, civil servants, and their dependents in private centres. Out of pocket payment (self-funding) for new and prevalent dialysis in 2023 were 20% and 11% respectively. Funding from NGO bodies was 1.5% in 2023 (Table & Figure 2.1.6).

Table 2.1.6: Funding for Dialysis Treatment 2014-2023

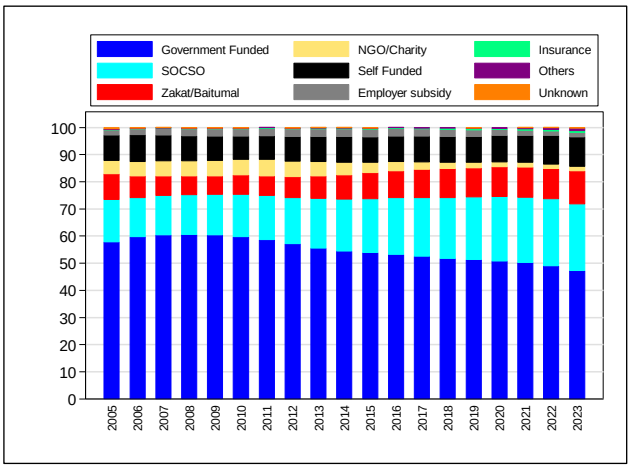
Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
% Government Funded	41.6	48.1	46.8	46.5	46.4	45.3	47	50.2	49.4	47.9
% SOCSO	18.8	20.2	18.9	19.4	19.1	18.8	18.7	17.4	15.4	14.8
% Zakat/Baitumal	11.4	9.9	10.8	10.6	9.3	10.1	9.8	7.3	8.1	8
% NGO/Charity	2.8	1.9	1.7	1.8	2.5	3.1	2.7	4.5	5.4	6.1
% Self Funded	19.6	17.6	19.3	18	18.6	17.7	17.5	17	17.7	19.5
% Employer Subsidized	1.1	1.1	1.3	2.7	2.5	2.8	3.1	2.5	2.8	2.6
% Insurance	1.3	0.9	0.8	0.6	0.6	0.6	0.7	0.5	0.4	0.5
% Others	2.2	0.2	0.2	0.3	0.5	0.5	0.2	0.1	0	0.1
% Unknown	1.2	0.1	0.2	0.1	0.5	1.1	0.3	0.5	0.8	0.5
Dialysing at 31st December	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068
% Government Funded	47	48.9	50	50.6	51.2	51.6	52.2	53	53.6	54
% SOCSO	24.5	24.6	24	23.5	22.9	22.3	21.6	20.9	19.8	19.1
% Zakat/Baitumal	12.2	11.3	11.1	10.9	10.7	10.5	10.3	9.8	9.6	9.1
% NGO/Charity	1.5	1.5	1.6	1.8	2	2.3	2.7	3.3	3.9	4.6
% Self Funded	11	10.6	10.2	10	10	9.9	9.7	9.6	9.5	9.6
% Employer Subsidized	1.6	1.7	1.9	2.2	2.4	2.5	2.7	2.8	2.8	2.9
% Insurance	0.8	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4
% Others	1	0.7	0.5	0.4	0.4	0.3	0.2	0.2	0.2	0.1
% Unknown	0.4	0.1	0.1	0.1	0	0.1	0.1	0	0.2	0.2

Figure 2.1.6: Funding for Dialysis Treatment 1969-2023

(i) New Dialysis Patients



(ii) Dialysis Patients at 31st December



2.1.7: Distribution of dialysis patients by sector

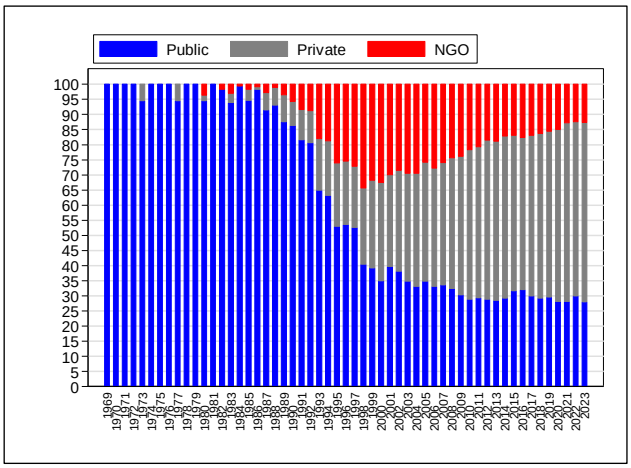
Private centres remained the largest provider of dialysis. Among new patients, 59% were accepted to private dialysis centres followed by government centres (28%) and NGO centres (13%). The proportion of patients dialysing at the private sector has been steadily increasing over the last 30 years, accounting for more than half of prevalent patients since 2018.

Table 2.1.7: Distribution of Dialysis Patients by Sector 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
% Government centre	27.9	29.9	28	28	29.5	29.2	29.9	31.9	31.6	29.2
% NGO centre	12.7	12.5	12.9	15.1	15.7	16.4	17	17.7	17	17.2
% Private centre	59.4	57.6	59.1	56.9	54.8	54.4	53.1	50.4	51.4	53.6
ESKD patients at 31st December	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068
% Government centre	29.1	29.9	30.1	30.2	30.6	30.8	31.1	31.3	31.1	30.8
% NGO centre	15.9	16.4	17	17.8	18.4	19	19.6	20.1	20.5	21.5
% Private centre	55	53.7	52.9	52	51	50.2	49.3	48.6	48.4	47.7

Figure 2.1.7: Distribution of Dialysis Patients by Sector 1969-2023

(i) New Dialysis Patients



(ii) Dialysis Patients at 31st December

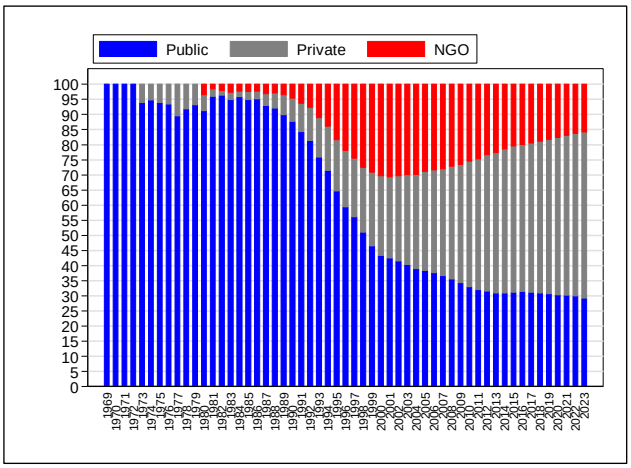


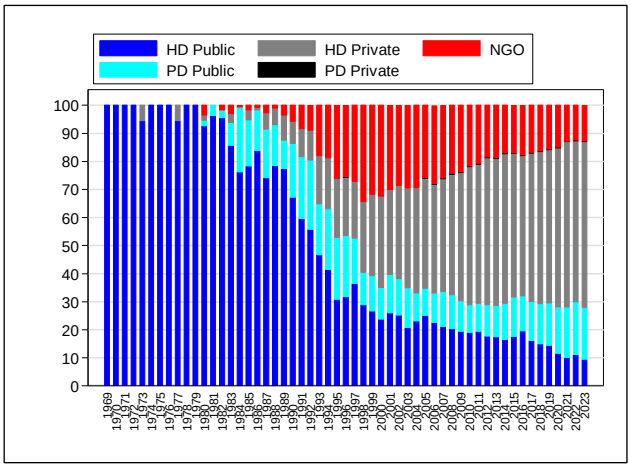
Table 2.1.7(a): Distribution of Dialysis Patients by Modality and Sector 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
% Public Centre	27.9	29.9	28.0	28.0	29.5	29.2	30.0	31.9	31.6	29.3
% HD Public Centre	9.3	11.1	10.0	11.5	14.4	14.9	16.1	19.5	17.5	16.4
% PD Public Centre	18.6	18.8	18.0	16.5	15.1	14.3	13.9	12.4	14.1	12.9
% NGO	12.8	12.5	12.9	15.1	15.7	16.4	16.9	17.8	17.1	17.2
% Private Centre	59.3	57.6	59.1	56.9	54.8	54.4	53.1	50.3	51.3	53.5
% HD Private Centre	59.2	57.4	59.0	56.8	54.7	54.2	52.9	50.2	51.2	53.3
% PD Private Centre	0.1	0.2	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2
ESKD patients at 31st December	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068
% Public Centre	29.1	29.9	30.2	30.2	30.6	30.8	31.1	31.3	31.1	30.8
% HD Public Centre	16.9	17.7	18.4	19.2	20.1	20.6	21.1	21.6	21.2	21.5
% PD Public Centre	12.2	12.2	11.8	11.0	10.5	10.2	10.0	9.7	9.9	9.3
% NGO	15.9	16.4	16.9	17.7	18.4	18.9	19.6	20.1	20.5	21.5
% Private Centre	55.0	53.7	52.9	52.1	51.0	50.3	49.3	48.6	48.4	47.7
% HD Private Centre	54.9	53.6	52.8	52.0	50.9	50.2	49.2	48.5	48.3	47.6
% PD Private Centre	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

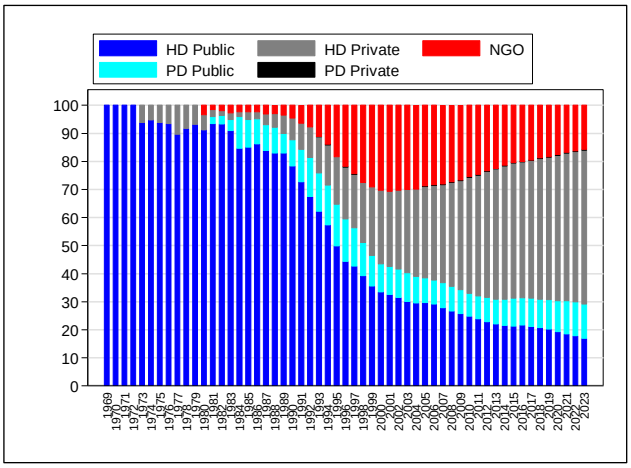
PD is almost exclusively provided by the public sector with the private providing only 0.1% of new and prevalent patients. The public sector continued to provide an increasing proportion of PD to new patients accounting for 18.6% in 2023 while the proportion of new HD patients in public HD centres declined to 9.3%. A similar trend is reflected in prevalent patients. (Table 2.1.7 (a) & Figure 2.1.7(a)).

Figure 2.1.7(a): Distribution of Dialysis Patients by Modality and Sector 1969-2023

(i) New Dialysis Patients



(ii) Dialysis Patients at 31st December



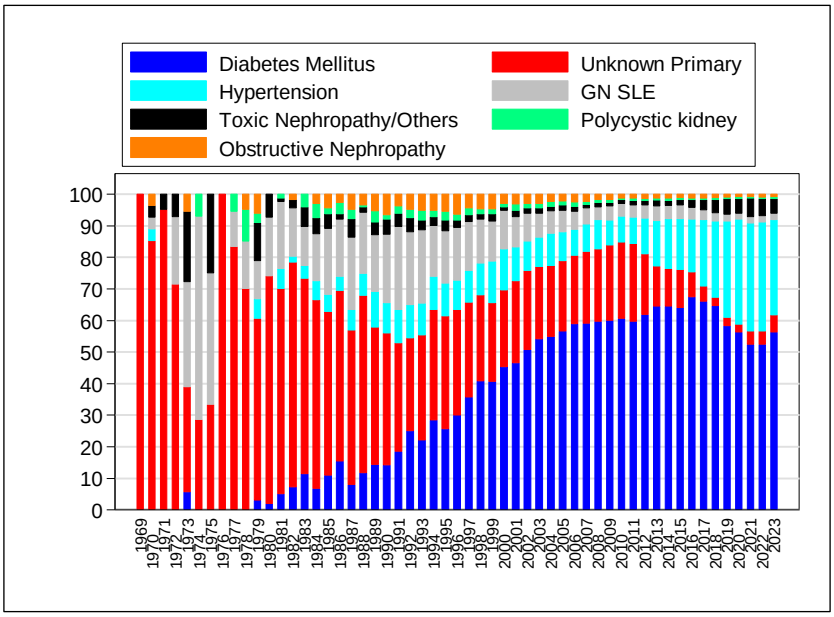
2.1.8: Primary renal disease

Diabetes mellitus remained the main cause of ESKD in new dialysis patients (56%) followed by hypertension (30%), unknown (5%) and glomerulonephritis/SLE (2%) (Table & Figure 2.1.8). Although the proportion of diabetes appeared to have declined, this was probably artifactual due to changes in the classification of diabetes as the primary renal disease from 2019. Other reasons include reminders to sites to check their patients' status of diabetes and verification with sites prior to migration to a new kidney transplant allocation system (MyKAS).

Table 2.1.8: Primary Renal Diseases for New Dialysis Patients 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
% Unknown cause	5.4	4.2	4.2	2.5	2.7	2.6	4.8	8	12.1	11.9
% Diabetes Mellitus	56.3	52.4	52.4	56.2	58.2	64.6	66	67.3	64	64.4
% GN/SLE	2.1	2	1.9	1.8	2.2	2.6	3.1	3.8	4.3	4.2
% Polycystic kidney	0.6	0.5	0.4	0.6	0.4	0.6	0.5	0.5	0.7	0.7
% Obstructive Nephropathy	0.9	1	0.9	0.9	1.1	1.2	1.4	1.4	1.2	1.4
% Toxic Nephropathy	0.4	0.4	0.4	0.5	0.8	0.9	1	0.8	0.5	0.5
% Hypertension	30.1	34.5	34.2	33.3	30.5	24.2	21	16.6	16	15.8
% Others	4.2	5.0	5.6	4.2	4.1	3.3	2.2	1.6	1.2	1.1

Figure 2.1.8: Primary Renal Diseases for New Dialysis Patients 1969-2023



SECTION 2.2: GROWTH OF DIALYSIS IN MALAYSIA

2.2.1: Growth in dialysis in Malaysia by sector

The number of dialysis centres (PD and HD Centres combined) for the whole of Malaysia has exceeded 1,000 in 2023. The number of dialysis centres has grown steadily from 759 in 2014 to 1,040 in 2023. The increase in number of dialysis centres was mainly contributed by the private dialysis centres, which grew from 410 in 2014 to 638 in 2023. During the same period, the number of NGO centres increased from 159 to 165 while the number of public dialysis centres increased from 190 to 237. The number of private dialysis centres predominates in the west coast of Peninsula Malaysia. The number of public PD centres has increased from 36 to 58 from 2014 to 2023 while the number of private PD centres has remained below 10.

Table 2.2.1: Number of Dialysis, HD and PD Centres in Malaysia by Sector, Year 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Public Centres	237	230	227	222	217	210	207	206	196	190
NGO Centres	165	163	159	156	157	162	161	160	159	159
Private Centres	638	593	533	489	467	447	447	433	419	410
HD Centres										
Public HD Centres	179	176	177	176	173	169	169	168	159	154
NGO HD Centres	165	163	159	156	157	162	161	160	159	159
Private HD Centres	629	584	526	482	460	440	437	423	411	402
PD Centres										
Public PD Centres	58	54	50	46	44	41	38	38	37	36
NGO PD Centres	0	0	0	0	0	0	0	0	0	0
Private PD Centres	9	9	7	7	7	7	10	10	8	8

Figure 2.2.1(a): Number of Dialysis Centre in Malaysia by Sector, 1969-2023

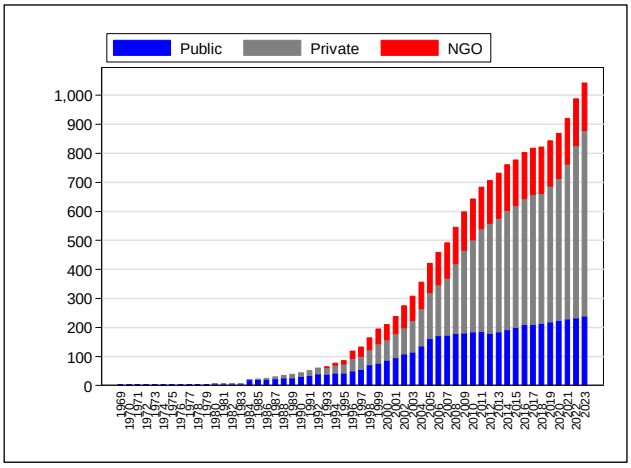
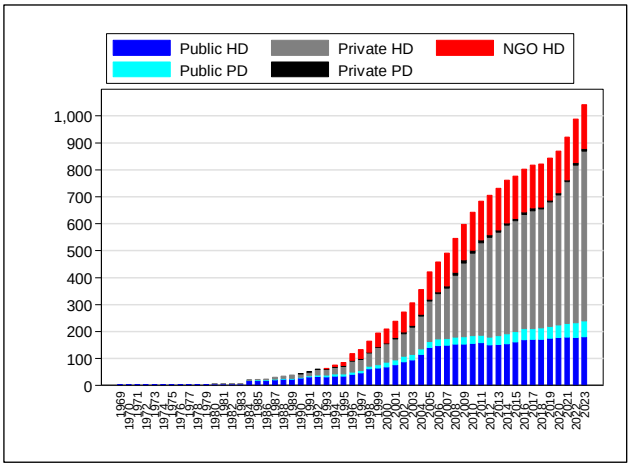


Figure 2.2.1(b): Number of HD and PD Centre in Malaysia by Sector, 1969-2023



The private sector is the largest provider of dialysis for providing HD to 875 pmp while the public sector dominates the PD services with a prevalence rate of 195 pmp. The private sector contributed only 2 pmp of patients on PD.

Table 2.2.2: Prevalence Rate of Dialysis (HD+PD), HD and PD Patients in Malaysia by Sector, 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Dialysis patients, pmp										
Public	463	471	459	466	452	435	425	415	391	362
NGO	254	257	259	275	273	269	268	266	257	252
Private	877	846	807	804	753	711	674	643	607	560
HD patients, pmp										
Public	269	279	280	296	297	291	288	286	267	252
NGO	254	257	259	275	273	269	268	266	257	252
Private	875	844	805	803	752	710	673	642	607	559
PD patients, pmp										
Public	195	192	179	170	155	144	137	129	124	110
NGO	0	0	0	0	0	0	0	0	0	0
Private	2	2	1	1	1	1	1	1	1	1

Figure 2.2.2(a): Prevalence Rate of Dialysis Patient (HD+PD) Malaysia by Sector, 1969-2023

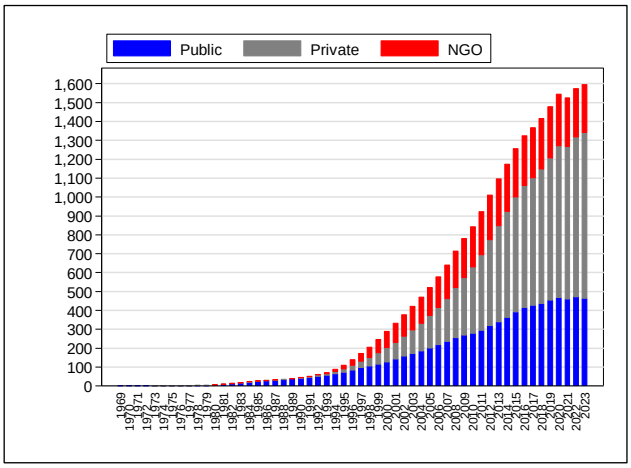
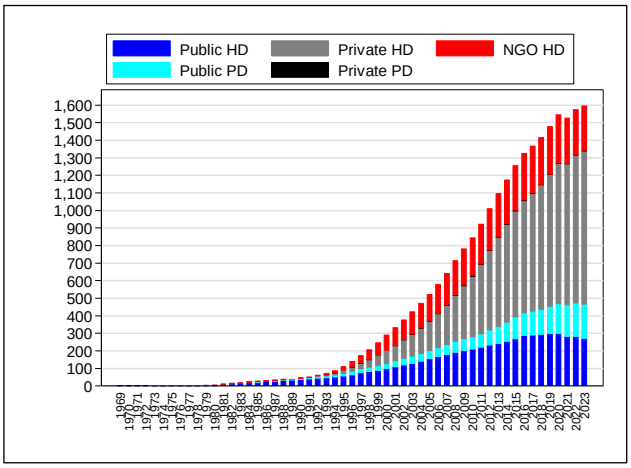


Figure 2.2.2(b): Prevalence Rate of HD and PD Patient in Malaysia by Sector, 1969-2023



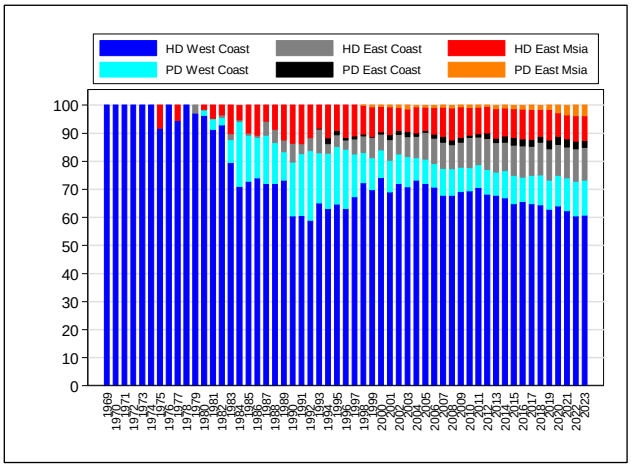
2.2.3: Growth in dialysis in Malaysia by region

Table 2.2.3: Distribution of Dialysis Patients by Modality and Region 2014-2023

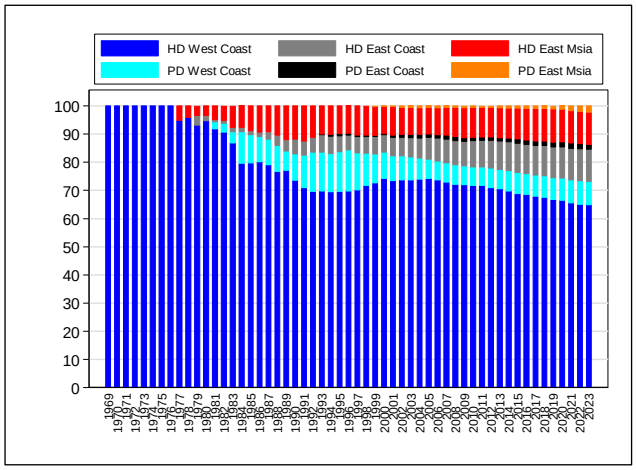
Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Dialysis patients	10027	10037	9351	9420	9426	8494	8046	8072	8006	7601
% West Coast	73.1	72.8	73.9	74.7	73.3	75.1	74.8	74.2	74.8	76.5
% East Coast	14.2	14.2	14	13.9	14.2	13.8	12.9	13.6	13.6	12.4
% East Msia	12.7	13	12.1	11.4	12.5	11.1	12.3	12.2	11.6	11.1
New HD patients	8150	8132	7659	7856	7992	7263	6913	7065	6869	6604
% West Coast	74.7	74.6	76	76.6	74.1	75.2	75.4	75	75.5	77
% East Coast	14.5	14.2	13.6	13.3	13.1	13.6	12.1	12.8	12.6	11.6
% East Msia	10.8	11.2	10.4	10.1	12.8	11.2	12.5	12.2	11.9	11.4
New PD patients	1877	1905	1692	1564	1434	1231	1133	1007	1137	997
% West Coast	66.1	65.1	64.3	65.5	68.5	74.1	71.1	69.2	70.6	73.2
% East Coast	13.3	14.3	16.2	16.9	20.8	15.4	17.7	19.5	19.9	17.6
% East Msia	20.6	20.6	19.5	17.6	10.7	10.5	11.2	11.3	9.5	9.2
Dialysing at 31st Dec	53210	51481	49995	49992	47212	44625	42521	40634	38003	35068
% West Coast	73.1	73.3	73.6	74.2	74.4	74.9	75.3	75.8	76.3	76.9
% East Coast	13.1	13.2	13.1	12.8	12.6	12.4	12.1	12	11.9	11.6
% East Msia	13.8	13.5	13.3	13	13	12.7	12.6	12.2	11.8	11.5
HD Dialysing at 31st Dec	46659	45147	44074	44457	42219	40045	38219	36645	34212	31763
% West Coast	73.9	74.1	74.3	74.6	74.5	75.1	75.5	76	76.4	76.9
% East Coast	13	12.9	12.7	12.4	12.2	12	11.7	11.6	11.5	11.3
% East Msia	13.1	13	13	13	13.3	12.9	12.8	12.4	12.1	11.8
PD Dialysing at 31st Dec	6551	6334	5921	5535	4993	4580	4302	3989	3791	3305
% West Coast	67.6	67.6	68.6	70.9	73	73.6	73.7	74.1	75.3	76.3
% East Coast	13.9	15.2	16.4	16.5	16.3	15.7	16.2	16.2	15.9	14.4
% East Msia	18.5	17.2	15	12.6	10.7	10.7	10.1	9.7	8.8	9.3

Figure 2.2.3: Distribution of Dialysis Patients by Modality and Region 1969-2023

(i) New Dialysis Patients



(ii) ESKD Patients at 31st December



Most new dialysis patients are from the West Coast comprising 73% in 2023. Compared to 2014, there has been a slight increase (about 2%) in proportion of patients from East Coast and East Malaysia. There is an increase in provision of peritoneal dialysis in East Malaysia. The proportion of new PD patients from East Malaysia has doubled from 9.2% in 2014 to 20.6% in 2023. This is also reflected in the increase in the proportion of prevalent patients on PD from East Malaysia, increasing from 9.3% in 2014 to 18.5% in 2023. (Table 2.2.3 & Figures 2.2.3 (i) & (ii)).

Table 2.2.4: Number and Prevalence Rate of Dialysis Patients (HD & PD) in Malaysia by State and Sector, 2019-2023

State	Sector	Year 2023		Year 2022		Year 2021		Year 2020		Year 2019	
		N	PMP	N	PMP	N	PMP	N	PMP	N	PMP
Malaysia	Public	15469	463	15406	471	15059	459	15082	466	14454	452
	Private	29263	877	27657	846	26439	807	26017	804	24052	753
	NGO	8478	254	8418	257	8497	259	8893	275	8706	272
	Total	53210	1594	51481	1574	49995	1525	49992	1545	47212	1478
Johor	Public	1454	355	1413	351	1332	331	1350	337	1300	346
	Private	5106	1245	4968	1233	4815	1198	4645	1158	4316	1148
	NGO	1476	360	1533	381	1589	395	1694	422	1696	451
	Total	8036	1960	7914	1965	7736	1924	7689	1918	7312	1944
Kedah	Public	1135	519	1155	534	1177	547	1122	526	1056	486
	Private	2248	1028	2019	933	2010	934	1969	924	1853	852
	NGO	358	164	360	166	374	174	407	191	417	192
	Total	3741	1710	3534	1634	3561	1655	3498	1641	3326	1530
Kelantan	Public	915	493	911	498	903	498	936	522	891	473
	Private	1034	557	903	493	840	463	859	479	771	409
	NGO	246	132	231	126	225	124	221	123	201	107
	Total	2195	1182	2045	1117	1968	1086	2016	1125	1863	989
Melaka	Public	395	384	393	390	386	384	390	391	372	401
	Private	1462	1423	1397	1385	1268	1262	1190	1192	1099	1184
	NGO	226	220	234	232	230	229	223	223	204	220
	Total	2083	2027	2024	2007	1884	1875	1803	1806	1675	1804
Negeri Sembilan	Public	799	653	797	660	789	655	810	675	789	701
	Private	1139	930	1047	867	1008	837	959	799	922	819
	NGO	552	451	575	476	596	495	581	484	533	473
	Total	2490	2034	2419	2002	2393	1987	2350	1958	2244	1993
Pahang	Public	953	580	1009	625	990	618	967	608	940	562
	Private	1313	799	1215	753	1137	710	1031	648	953	570
	NGO	317	193	312	193	315	197	326	205	324	194
	Total	2583	1572	2536	1571	2442	1525	2324	1460	2217	1326
Perak	Public	1311	516	1296	515	1298	516	1307	524	1223	487
	Private	3186	1254	3212	1277	3112	1237	3089	1237	2788	1111
	NGO	671	264	642	255	641	255	646	259	639	255
	Total	5168	2034	5150	2048	5051	2008	5042	2020	4650	1853

State	Sector	Year 2023		Year 2022		Year 2021		Year 2020		Year 2019	
		N	PMP	N	PMP	N	PMP	N	PMP	N	PMP
Perlis	Public	133	454	129	445	107	372	97	341	90	354
	Private	113	386	105	362	102	355	107	376	108	425
	NGO	38	130	37	128	39	136	51	179	53	209
	Total	284	970	271	935	248	862	255	895	251	988
Pulau Pinang	Public	463	261	479	275	485	279	477	274	468	265
	Private	2194	1238	2126	1221	2028	1166	2010	1155	1852	1047
	NGO	849	479	875	503	918	528	937	538	933	527
	Total	3506	1979	3480	1999	3431	1972	3424	1967	3253	1839
Sabah	Public	1919	534	1853	543	1773	520	1772	518	1730	443
	Private	602	168	584	171	576	169	571	167	552	141
	NGO	296	82	287	84	288	84	303	89	291	75
	Total	2817	784	2724	798	2637	773	2646	774	2573	659
Sarawak	Public	1878	748	1817	735	1686	684	1619	660	1512	539
	Private	1212	483	1116	451	1037	421	972	396	893	318
	NGO	1288	513	1210	489	1153	468	1133	462	1047	373
	Total	4378	1745	4143	1675	3876	1572	3724	1518	3452	1230
Selangor	Public	1889	262	1938	275	1923	274	2018	289	1957	301
	Private	6711	931	6191	878	5840	833	5996	857	5602	861
	NGO	1185	164	1168	166	1175	168	1325	189	1311	202
	Total	9785	1358	9297	1319	8938	1274	9339	1335	8870	1363
Terengganu	Public	1114	921	1145	965	1158	989	1158	1007	1081	869
	Private	805	666	763	643	709	606	628	546	521	419
	NGO	286	236	281	237	278	237	292	254	288	231
	Total	2205	1823	2189	1845	2145	1832	2078	1808	1890	1519
WP Labuan	Public	117	1176	110	1135	113	1178	104	1095	100	1007
	Private	0	0	0	0	0	0	0	0	0	0
	NGO	0	0	0	0	0	0	0	0	0	0
	Total	117	1176	110	1135	113	1178	104	1095	100	1007
WP Putrajaya	Public	84	705	60	512	46	399	46	421	51	492
	Private	33	277	33	282	34	295	32	293	28	270
	NGO	0	0	0	0	0	0	0	0	0	0
	Total	117	982	93	794	80	693	78	714	79	763
WP Kuala Lumpur	Public	910	455	901	459	893	455	909	459	894	502
	Private	2105	1053	1978	1009	1923	979	1959	988	1794	1006
	NGO	690	345	673	343	676	344	754	380	769	431
	Total	3705	1854	3552	1811	3492	1778	3622	1827	3457	1939

The private sector is the main provider of dialysis on the West Coast (58%) while the public sector is the main provider in East Malaysia (54%) and on the East Coast (43%). NGO provides dialysis to 22% of patients in East Malaysia followed by 15% on the West Coast, and 12% on the East Coast (Table 2.2.4).

Among the states with the highest acceptance rate (at least 300 pmp), the private sector provided dialysis to the majority of patients (i.e. more than 50%) with the exception of Terengganu where the public sector is the largest sector providing dialysis to 50.5% of patients. In contrast, public sector is the main provider of dialysis in the states with the lowest acceptance rate (less than 200 pmp). This is exemplified by Sabah where public sector provided dialysis to 68% of patients with the private and NGO sectors contributing 21% and 11% respectively.

Data Definition for Diabetes as the Primary Renal Disease

1. Prior to 2017 when data was submitted in paper form, primary and secondary causes of renal disease were allowed. The National Renal Registry (NRR) office adjudicated discrepancies in the data submitted to determine the primary renal disease (PRD).

- If the PRD was recorded as unknown and patient has diabetes as the secondary cause or diabetes was included as a co-morbidity, the PRD was amended to diabetes.
- If there was a discrepancy in PRD reported between centres, one as unknown and the other as diabetes, the PRD was amended to diabetes

2. In 2017 data collection migrated to eNRR, an online electronic form. From 2017 and 1st February 2021, the system allowed more than one PRD. The determination of PRD was based on the following algorithm:

- If both unknown and diabetes were selected as PRD, diabetes was recorded as the PRD
- If the PRD was recorded as unknown and diabetes was included as a co-morbidity, the PRD was amended to diabetes.
- If there was a discrepancy in PRD reported between centres, the PRD at first notification was used
- If multiple PRDs were entered, the order for PRD determination is as follows:
  1 ADPKD
  2 Hereditary nephritis, specify
  3 Glomerulonephritis, specify
  4 Obstructive uropathy, specify
  5 Drugs / toxic nephropathy
  6 Diabetes Mellitus
  7 Hypertension
  8 Others, specify
  9 Unknown
  Examples:
  If ‘Unknown’ & ‘diabetes’ were selected as PRD then PRD is diabetes
  If ‘diabetes’ & ‘ADPKD’ were selected as PRD then PRD is ADPKD
  If ‘Unknown’ was selected as PRD and Comorbidities include diabetes then PRD is diabetes
  If ‘Unknown’ was selected as PRD and Comorbidities include hypertension then PRD is hypertension
- Change in PRD is permitted with written request and documentation from the source data providers to NRR

3. From 2nd February 2021 onwards

- Only a single entry for PRD is permitted
- If there was a discrepancy in PRD reported between centres, the PRD at first notification was used
- If PRD is unknown and diabetes is included in comorbidity at notification, “Unknown” PRD is maintained
- Change in PRD is permitted with written request and documentation from the source data providers to NRR

CHAPTER 3

DEATH AND SURVIVAL ON DIALYSIS

Loh Chek Loong
Liu Wen Jiun
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SECTION 3.1: DEATH ON DIALYSIS

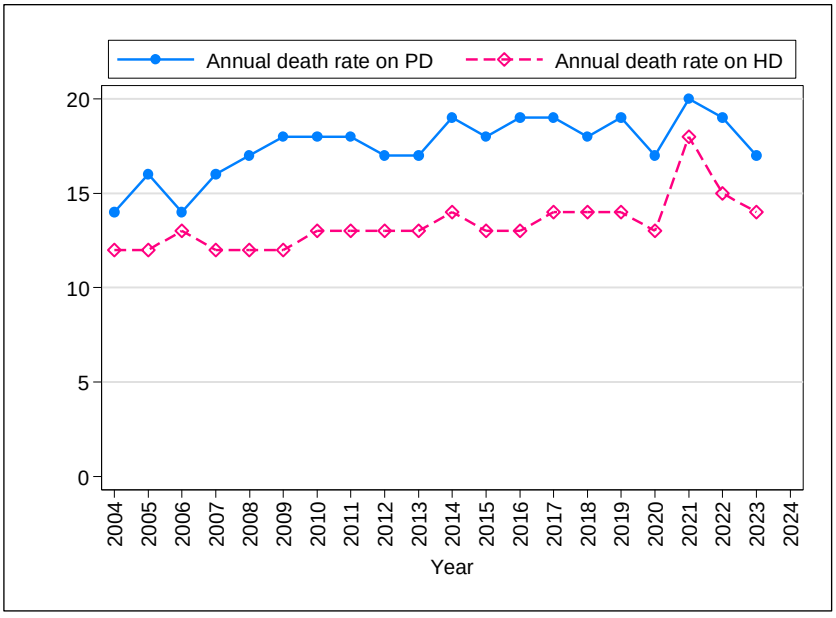
The annual crude death rate on dialysis in 2023 was 14% (Table 3.1.1). The annual crude death rate among haemodialysis patients was 14% while chronic peritoneal dialysis patients had a rate of 17%.

Over the past two decades, the annual crude death rate of patients on PD has consistently been higher than that of patients on HD. (Figure 3.1.1). This constitutes a major reason for PD drop out. It has been postulated that the difference in annual death rate between the two modalities are due to the negative selection of patients for peritoneal dialysis and the changing of modality from HD to PD due to severe cardiovascular disease.

Table 3.1.1: Deaths on dialysis 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Number of dialysis patients at risk	52346	50738	49994	48602	45919	43573	41578	39319	36536	33671
Dialysis deaths	7527	8034	9091	6359	6495	6153	5949	5402	5003	4728
Dialysis death rate %	14	16	18	13	14	14	14	14	14	14
Number of HD patients at risk	45903	44611	44266	43338	41132	39132	37432	35429	32988	30585
HD deaths	6419	6850	7922	5477	5602	5334	5174	4671	4372	4152
HD death rate %	14	15	18	13	14	14	14	13	13	14
Number of PD patients at risk	6443	6128	5728	5264	4787	4441	4146	3890	3548	3086
PD deaths	1108	1184	1169	882	893	819	775	731	631	576
PD death rate %	17	19	20	17	19	18	19	19	18	19

Figure 3.1.1: Death rates on dialysis 2004-2023



Traditionally, cardiovascular disease has been the primary contributor to mortality among our patients, with a notable portion of at-home deaths often attributed to cardiac events. However, over the past three years, infections have emerged as the leading reported cause of death, even as the impact of the COVID-19 pandemic has waned. In 2023, 36.2% of reported deaths were due to infections, surpassing the 33.9% attributed to cardiovascular causes.

Over the past 10 years, cause of death from CRBSI has increased in an alarming manner. This is not surprising as 23.5% of our HD patients are either on cuffed or non-cuffed catheter for their dialysis treatment.

Prior to 2023, peritonitis-related deaths in PD patients were defined based on the cause of death as documented by the attending doctor. However, starting in December 2022, the definition was broadened to include any PD patient who died within one month of the onset of a peritonitis episode, regardless of the stated cause of death. This change, reflected in the ISPD guidelines on peritonitis and supported by published studies on PD, has led to a significant increase in the reported rates of peritonitis-related deaths.

Table 3.1.2: Causes of death on dialysis 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Causes of Death (Dialysis)										
Cardiovascular	1770	23.5	1969	24.6	2041	22.4	1875	29.5	1994	30.7
Died at home	784	10.4	918	11.5	1046	11.5	873	13.7	994	15.3
Infection	2350	31.2	2948	36.8	3370	37.1	1591	25	1412	21.7
CRBSI	176	2.3	180	2.2	124	1.4	105	1.7	102	1.6
PD peritonitis	202	2.7	97	1.2	80	0.9	56	0.9	67	1
GIT bleed	105	1.4	118	1.5	113	1.2	88	1.4	93	1.4
Cancer	182	2.4	182	2.3	161	1.8	138	2.2	162	2.5
Liver disease	19	0.3	17	0.2	23	0.3	34	0.5	19	0.3
Withdrawal	185	2.5	64	0.8	96	1.1	66	1	95	1.5
Accidental Death	54	0.7	65	0.8	54	0.6	48	0.8	59	0.9
Pulmonary Causes	194	2.6	218	3	462	5	376	6	517	8
Others	636	8.4	878	11	943	10	493	8	404	6
Unknown	871	11.6	361	5	580	6	615	10	577	9
Total	7528	100	8015	100	9093	100	6358	100	6495	100
Causes of Death (HD)										
Cardiovascular	1556	24.2	1718	25.1	1842	23.2	1647	30.1	1780	31.8
Died at home	608	9.5	699	10.2	745	9.4	638	11.7	723	12.9
Infection	2046	31.9	2547	37.3	2946	37.2	1356	24.8	1226	21.9
CRBSI	176	2.7	180	2.6	124	1.6	105	1.9	102	1.8
GIT bleed	96	1.5	101	1.5	99	1.2	79	1.4	78	1.4
Cancer	171	2.7	169	2.5	151	1.9	133	2.4	153	2.7
Liver disease	19	0.3	17	0.2	23	0.3	31	0.6	19	0.3
Withdrawal	172	2.7	53	0.8	93	1.2	65	1.2	84	1.5
Accidental Death	52	0.8	55	0.8	48	0.6	45	0.8	54	1
Pulmonary Causes	167	2.6	192	3	419	5	356	7	490	9
Others	592	9.2	821	12	909	11	464	8	365	7
Unknown	764	11.9	282	4	526	7	557	10	528	9
Total	6419	100	6834	100	7925	100	5476	100	5602	100

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Causes of Death (PD)										
Cardiovascular	214	19.3	251	21.3	199	17	228	25.9	214	24
Died at home	176	15.9	219	18.5	301	25.8	235	26.6	271	30.3
Infection	304	27.4	401	34	424	36.3	235	26.6	186	20.8
PD peritonitis	202	18.2	97	8.2	80	6.8	56	6.3	67	7.5
GIT bleed	9	0.8	17	1.4	14	1.2	9	1	15	1.7
Cancer	11	1.0	13	1.1	10	0.9	5	0.6	9	1
Liver disease	0	0.0	0	0	0	0	3	0.3	0	0
Withdrawal	13	1.2	11	0.9	3	0.3	1	0.1	11	1.2
Accidental Death	2	0.2	10	0.8	6	0.5	3	0.3	5	0.6
Pulmonary Causes	27	2.4	26	2	43	4	20	2	27	3
Others	44	4.0	57	5	34	3	29	3	39	4
Unknown	106	9.6	79	7	54	5	58	7	49	5
Total	1108	100	1181	100	1168	100	882	100	893	100

** Died due to COVID-19, 2023: HD 56, and PD 12, 2022: HD 512, and PD 75, 2021: HD 1436, and PD 175, 2020: HD 36, and PD 3*

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Causes of Death (Dialysis)										
Cardiovascular	1841	29.9	1888	31.7	1831	33.9	1749	35	1742	36.8
Died at home	999	16.2	954	16	771	14.3	721	14.4	676	14.3
Infection	1518	24.7	1453	24.4	1471	27.2	1246	24.9	1136	24
CRBSI	94	1.5	87	1.5	55	1	58	1.2	52	1.1
PD peritonitis	66	1.1	75	1.3	55	1	49	1	51	1.1
GIT bleed	105	1.7	91	1.5	88	1.6	79	1.6	78	1.6
Cancer	148	2.4	166	2.8	150	2.8	120	2.4	125	2.6
Liver disease	23	0.4	24	0.4	25	0.5	23	0.5	34	0.7
Withdrawal	51	0.8	72	1.2	65	1.2	58	1.2	51	1.1
Accidental Death	51	0.8	55	0.9	50	0.9	40	0.8	36	0.8
Pulmonary Causes	398	6	201	3	42	1	33	1	15	0
Others	402	7	336	6	212	4	189	4	155	3
Unknown	457	7	547	9	587	11	638	13	577	12
Total	6153	100	5949	100	5402	100	5003	100	4728	100
Causes of Death (HD)										
Cardiovascular	1642	30.8	1697	32.8	1655	35.4	1588	36.3	1593	38.4
Died at home	771	14.5	718	13.9	557	11.9	537	12.3	525	12.6
Infection	1309	24.5	1280	24.7	1259	27	1099	25.1	985	23.7
CRBSI	94	1.8	87	1.7	55	1.2	58	1.3	52	1.3
GIT bleed	94	1.8	79	1.5	80	1.7	69	1.6	71	1.7
Cancer	142	2.7	159	3.1	145	3.1	114	2.6	121	2.9
Liver disease	23	0.4	23	0.4	25	0.5	23	0.5	34	0.8
Withdrawal	47	0.9	54	1	55	1.2	52	1.2	49	1.2
Accidental Death	49	0.9	53	1	47	1	39	0.9	36	0.9
Pulmonary Causes	373	7	197	4	41	1	30	1	14	0
Others	374	7	317	6	201	4	177	4	150	4
Unknown	416	8	510	10	551	12	586	13	522	13
Total	5334	100	5174	100	4671	100	4372	100	4152	100

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Causes of Death (PD)										
Cardiovascular	199	24.3	191	24.6	176	24.1	161	25.5	149	25.9
Died at home	228	27.8	236	30.5	214	29.3	184	29.2	151	26.2
Infection	209	25.5	173	22.3	212	29	147	23.3	151	26.2
PD peritonitis	66	8.1	75	9.7	55	7.5	49	7.8	51	8.9
GIT bleed	11	1.3	12	1.5	8	1.1	10	1.6	7	1.2
Cancer	6	0.7	7	0.9	5	0.7	6	1	4	0.7
Liver disease	0	0	1	0.1	0	0	0	0	0	0
Withdrawal	4	0.5	18	2.3	10	1.4	6	1	2	0.3
Accidental Death	2	0.2	2	0.3	3	0.4	1	0.2	0	0
Pulmonary Causes	25	3	4	1	1	0	3	0	1	0
Others	28	3	19	2	11	2	12	2	5	1
Unknown	41	5	37	5	36	5	52	8	55	10
Total	819	100	775	100	731	100	631	100	576	100

SECTION 3.2: PATIENT SURVIVAL ON DIALYSIS

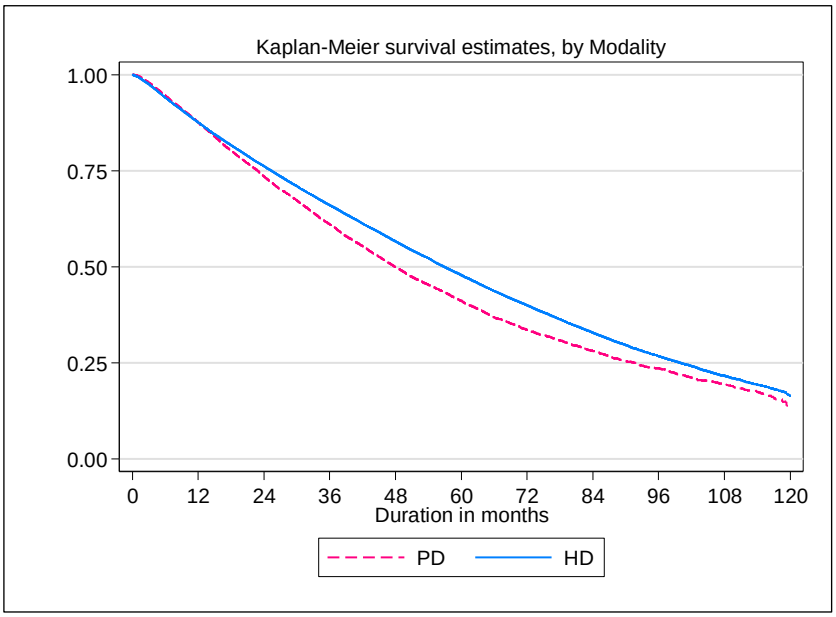
3.2.1: Patient survival by type of dialysis modality

The overall unadjusted 5 years and 10 years patient survival on dialysis; analysed as per ITT (patient not censored for change in dialysis modality) were 47% and 16% respectively (Table 3.2.1). The unadjusted patient survival for those on haemodialysis appeared to be superior compared to those on PD and this survival difference begins from 2nd year onwards.

Table 3.2.1: Patient survival by dialysis modality [ITT analysis (not censored for change of modality)], 2014-2023

Dialysis modality	PD			HD			All		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	13971	100		74456	100		88456	100	
6	12359	95	0	66266	94	0	78625	94	0
12	10573	88	0	57911	88	0	68484	88	0
24	7472	74	0	44156	76	0	51624	76	0
36	5173	61	0	33326	66	0	38499	65	0
48	3459	50	1	24317	57	0	27776	56	0
60	2241	41	1	16909	48	0	19150	47	0
72	1429	34	1	11317	40	0	12746	39	0
84	915	28	1	7060	33	0	7972	32	0
96	546	24	1	3869	27	0	4415	26	0
108	220	19	1	1639	22	0	1857	21	0
120	15	14	1	118	16	0	132	16	0

Figure 3.2.1: Patient survival by dialysis modality analysis (not censored for change of modality), 2014-2023



3.2.2: Patient survival by age at starting dialysis

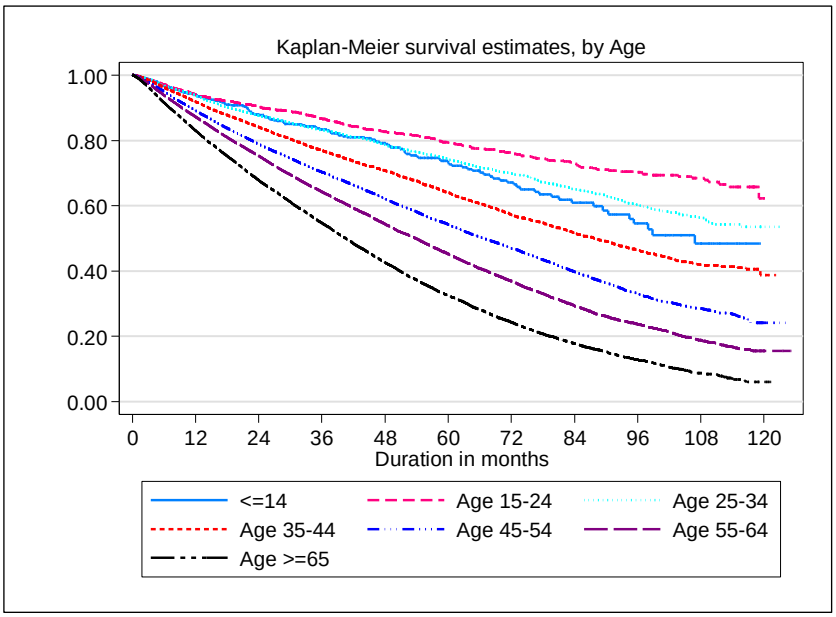
Age at starting dialysis has a major impact on survival with patients in the age group of 15 to 24 having the best outcome (Table 3.2.2 and Figure 3.2.2). Unadjusted 10 years survival of patients in this age group (15-24) was 10-fold better that those who were 65 years old and above. Unadjusted 5 years survival of patients who started dialysis after 65 years old is 32%.

Table 3.2.2: Unadjusted patient survival by age, 2014-2023

Age group (years)	<=14			15-24			25-34			35-44		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	604	100		2482	100		6515	100		11637	100	
6	532	97	1	2209	97	0	5746	97	0	10236	96	0
12	468	94	1	1932	94	0	5029	94	0	8848	92	0
24	355	88	1	1538	90	1	3817	88	0	6656	84	0
36	282	83	2	1223	87	1	3014	83	1	5055	77	0
48	222	79	2	958	83	1	2294	79	1	3770	71	1
60	153	73	2	726	79	1	1692	74	1	2630	64	1
72	102	67	3	541	76	1	1202	70	1	1820	57	1
84	64	61	3	374	73	1	840	65	1	1222	52	1
96	37	55	4	245	70	1	477	60	1	728	46	1
108	15	48	5	124	68	2	214	57	1	292	42	1
120	1			10	62	4	10	54	2	10	39	2

Age group (years)	45-54			55-64			>=65		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	21015	100		29600	100		26188	100	
6	18576	95	0	25940	94	0	22396	92	0
12	16063	89	0	22288	87	0	18718	83	0
24	12091	79	0	16488	75	0	12931	68	0
36	9241	70	0	11902	64	0	8808	55	0
48	6822	62	0	8357	54	0	5694	43	0
60	4839	54	0	5646	45	0	3435	32	0
72	3287	47	0	3633	37	0	1995	24	0
84	2086	40	1	2109	29	0	1070	18	0
96	1141	33	1	1095	24	0	507	13	0
108	472	29	1	413	19	0	158	9	0
120	19	24	1	6	16	1	9	6	1

Figure 3.2.2: Unadjusted patient survival by age, 2014-2023



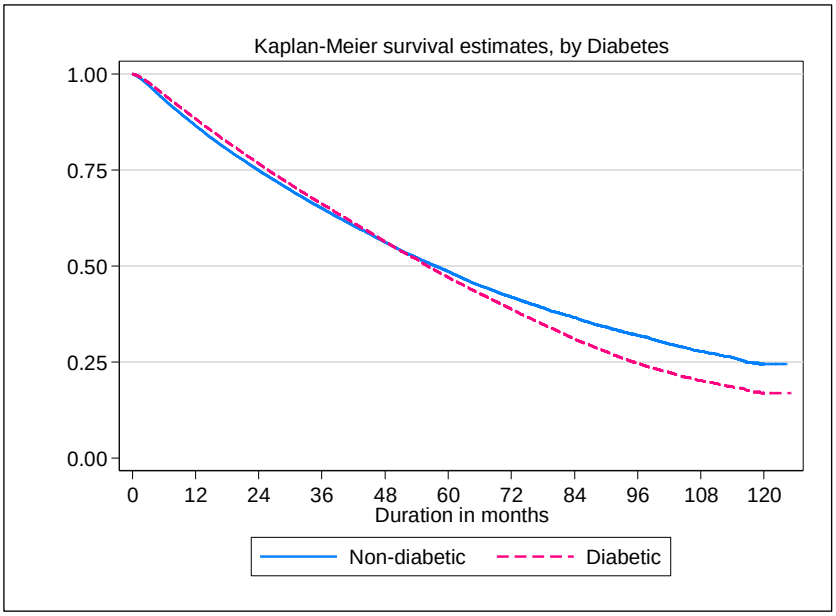
3.2.3: Patient survival by diabetic status

Similar to age at starting dialysis, the presence of diabetes mellitus has major impact on patient survival (Table 3.2.3 and Figure 3.2.3). The unadjusted patient survival began to diverge by 60 months after initiation of dialysis and 53% diabetic patients died within 5 years of initiating dialysis. The 10 years unadjusted patient survival among diabetics and non-diabetics were 17% and 24% respectively.

Table 3.2.3: Unadjusted patient survival by diabetes mellitus status, 2014-2023

Diabetes status	Non-diabetic			Diabetic		
Interval (month)	n	% survival	SE	n	% survival	SE
0	49797	100		41563	100	
6	42589	93	0	37595	95	0
12	35517	86	0	33413	88	0
24	24826	75	0	26035	77	0
36	17308	65	0	20105	66	0
48	12217	56	0	14475	56	0
60	8378	49	0	9821	47	0
72	5559	42	0	6463	39	0
84	3558	37	0	3877	31	0
96	2037	32	0	1982	25	0
108	851	28	0	788	20	0
120	7	24	1	35	17	1

Figure 3.2.3: Unadjusted patient survival by diabetes mellitus status, 2014-2023



3.2.4: Patient survival by 5 years era of starting dialysis

When unadjusted patient survival was analysed by 5 years era of starting dialysis, it appeared that patient survival has deteriorated over the last 20 years; with patients starting dialysis in the 2004-2008 era having the best outcome (Table 3.2.4 and Figure 3.2.4a). Despite adjusting for age and DM (major change in patient demography over the last 2 decades), the difference in patient survival persisted (Figure 3.2.4b). The overall mean age of patients starting dialysis remained almost same in the past 10 years (refer Table 2.1.4(a)).

Table 3.2.4: Unadjusted patient survival by 4 Era, 2004-2023

Year	2004-2008			2009-2013			2014-2018			2019-2023		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	19455	100		31914	100		43796	100		42830	100	
6	18016	94	0	29325	93	0	40502	94	0	43921	94	0
12	16622	88	0	27080	87	0	37244	88	0	35064	87	0
24	14292	77	0	23135	76	0	31510	76	0	21559	76	0
36	12337	68	0	19858	67	0	26837	67	0	11981	65	0
48	10658	60	0	16948	58	0	22477	57	0	5100	56	0
60	9202	52	0	14460	50	0	18676	48	0	62	49	1
72	7959	46	0	12212	43	0	12283	41	0	1		
84	6764	40	0	10267	37	0	7568	34	0	1		
96	5768	34	0	8588	31	0	4070	28	0	1		
108	4998	30	0	7186	27	0	1630	24	0	1		
120	4311	26	0	5946	22	0	21	20	0	1		

Figure 3.2.4(a): Unadjusted patient survival by 4 Era, 2004-2023

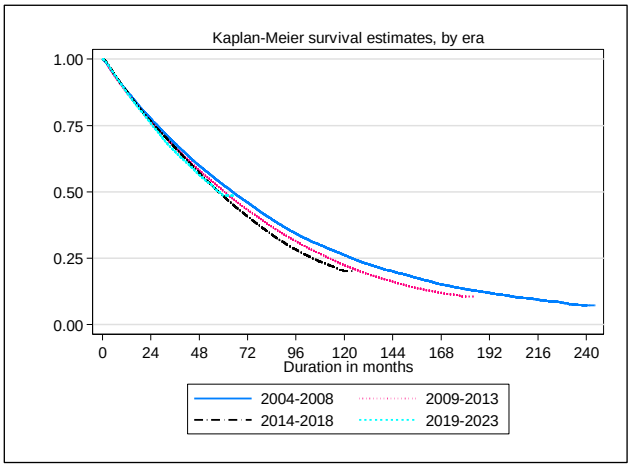


Figure 3.2.4(b): Adjusted for Age and Diabetes patient survival by 4 Era, 2004-2023

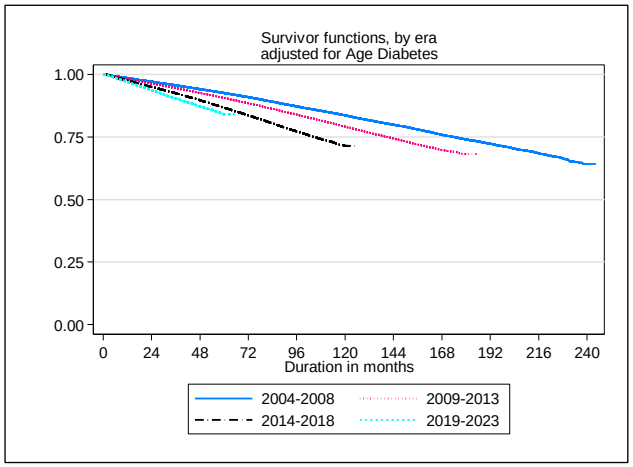


Table 3.2.5: Unadjusted HD patient survival by 4 Era, 2004-2023

Year	2004-2008			2009-2013			2014-2018			2019-2023		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	17042	100		27828	100		36842	100		42621	100	
6	15849	94	0	25682	93	0	34218	94	0	35648	94	0
12	14736	88	0	23860	87	0	31685	88	0	28794	88	0
24	12857	78	0	20686	77	0	27341	77	0	18233	76	0
36	11268	69	0	18022	68	0	23717	68	0	10409	66	0
48	9861	61	0	15602	59	0	20219	59	0	4518	58	0
60	8614	54	0	13463	52	0	17048	50	0	58	50	1
72	7518	47	0	11498	44	0	11382	42	0	1		
84	6435	41	0	9735	38	0	7069	35	0	1		
96	5545	35	0	8199	32	0	3826	30	0	1		
108	4825	31	0	6871	27	0	1549	25	0	1		
120	4178	27	0	5714	23	0	19	21	0	1		

Figure 3.2.5(a): Unadjusted HD patient survival by 4 Era, 2004-2023

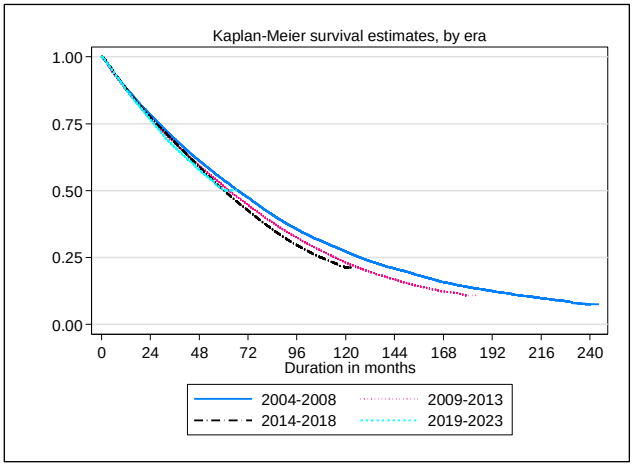


Figure 3.2.5(b): Adjusted for Age and Diabetes HD patient survival by 4 Era, 2004-2023

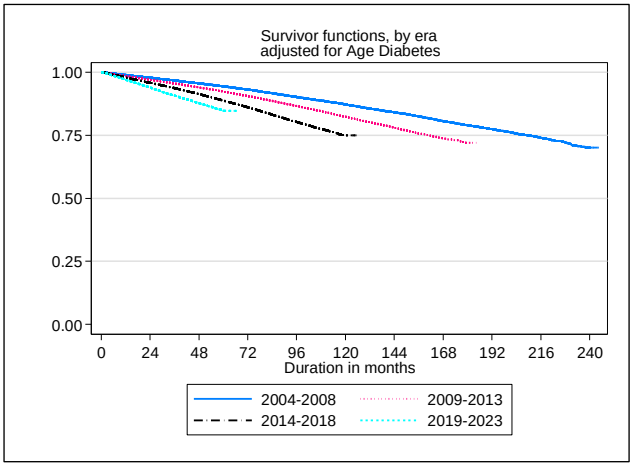


Table 3.2.6: Unadjusted PD patient survival by 4 Era, 2004-2023

Year	2004-2008			2009-2013			2014-2018			2019-2023		
Interval (month)	n	% survival	SE	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	2413	100		4086	100		6954	100		10209	100	
6	2167	93	1	3643	93	0	6284	93	0	8273	94	0
12	1886	85	1	3220	86	1	5559	86	0	6270	86	0
24	1435	71	1	2449	72	1	4169	71	1	3326	72	1
36	1069	60	1	1836	59	1	3120	58	1	1581	59	1
48	799	49	1	1348	48	1	2258	46	1	593	49	1
60	589	40	1	999	39	1	1628	37	1	6	39	2
72	442	33	1	714	31	1	901	29	1	1		
84	330	27	1	534	26	1	501	23	1	1		
96	224	21	1	389	21	1	244	19	1	1		
108	174	18	1	316	19	1	83	15	1	1		
120	134	15	1	234	15	1	3	14	1	1		

Figure 3.2.6(a): Unadjusted PD patient survival by 4 Era, 2004-2023

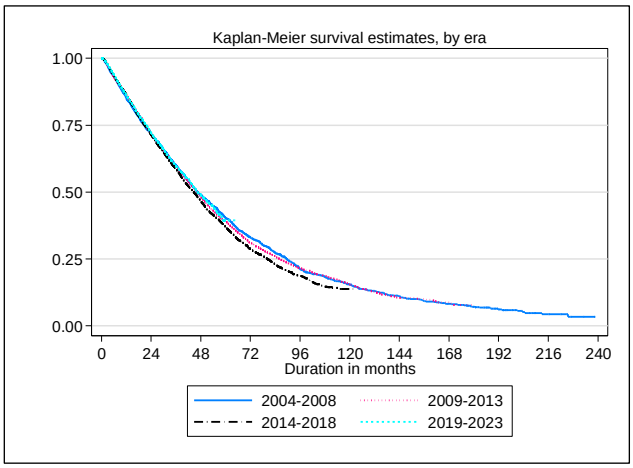
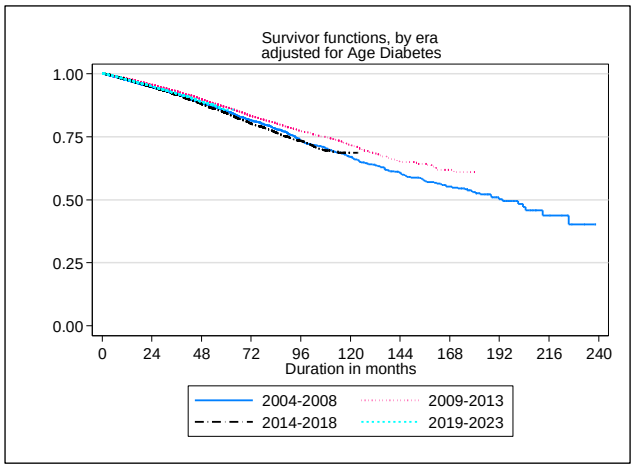


Figure 3.2.6(b): Adjusted for Age and Diabetes PD patient survival by 4 Era, 2004-2023



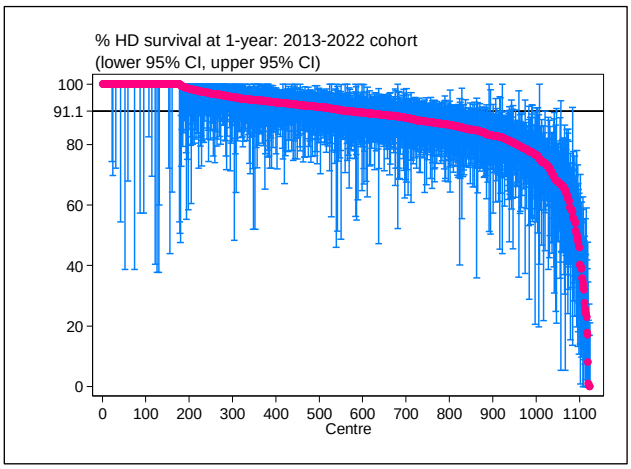
SECTION 3.3: SURVIVAL OF INCIDENT PATIENTS BY CENTRE

3.3.1: Survival of incident haemodialysis patients (2013-2022) by centre

The mean patient survival at 1 year (adjusted for age and diabetes) among haemodialysis centres for the 2013-2022 cohort was 91.1% [Figure 3.3.1(a)]. There was marked centre variation and when the 1-year patient survival of the individual haemodialysis centres were illustrated in the funnel plots [Figure 3.3.1(b)], only 374 haemodialysis centres (33.3%) and 565 haemodialysis centres (50.3%) lie within the 2SD and 3SD of the mean respectively.

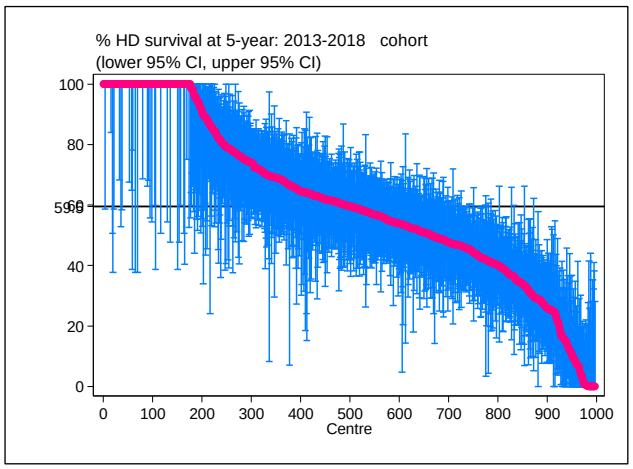
The 5 years mean patient survival (adjusted for age and diabetes) among haemodialysis centres for the 2013-2018 cohort was 59.5% [Figure 3.3.1(c)]. Similar to the 1-year patient survival, there was marked centre variation with only 36% and 52.8% of haemodialysis centres lie within 2SD and 3SD of the mean respectively [Figure 3.3.1(d)].

Figure 3.3.1(a): Variation in patient survival at 1-year among HD centres adjusted for age and diabetes mellitus status, 2013-2022



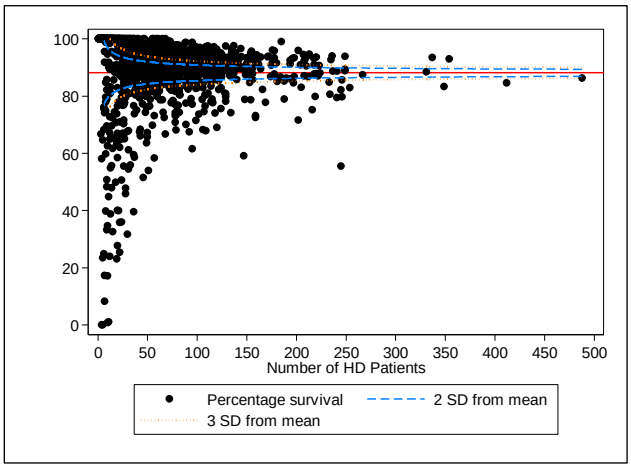
**Horizontal line represents the median % survival among HD centres*

Figure 3.3.1(c): Variation in patient survival at 5-years among HD centres adjusted for age and diabetes mellitus status, 2013-2018



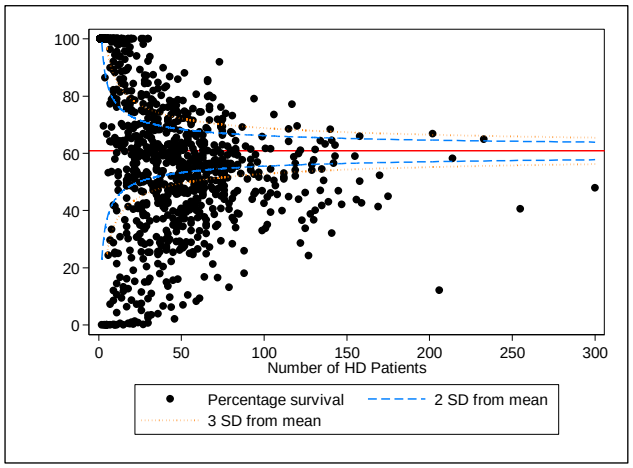
**Horizontal line represents the median % survival among HD centres*

Figure 3.3.1(b): Funnel plot at 1-year among HD centres adjusted for age and diabetes mellitus status, 2013-2022 cohort



**Horizontal line represents the mean % survival among HD centres*

Figure 3.3.1(d): Funnel plot for patient survival at 5-years among HD centres adjusted age and diabetes mellitus, 2013-2018 cohort



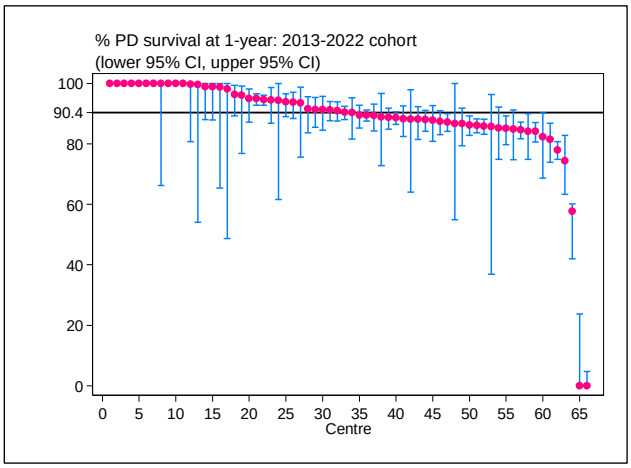
**Horizontal line represents the mean % survival among HD centres*

3.3.2: Survival of incident peritoneal dialysis patients (2013-2022) by centre

The mean patient survival at 1 year (adjusted for age and diabetes mellitus) among PD centres for the 2013-2022 cohort was 90.4% [Figure 3.3.2(a)]. Similar to haemodialysis centres, there was marked centre variation of 1-year patient survival among PD centres with only 39.1% and 60.9% of the centres within the 2SD and 3SD of the mean respectively [Figure 3.3.2(b)].

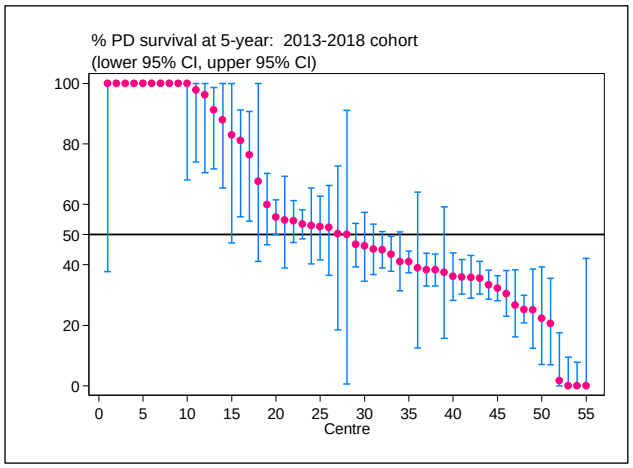
The 5 years mean patient survival (adjusted for age and diabetes mellitus) among PD centres for the 2013-2018 cohort was 50% [Figure 3.3.2(c)]. Similar to the 1-year survival, there was a wide variation in the 5-year survival among PD centres with only 31% and 39.7% of the centres within 2SD and 3SD of the mean respectively [Figure 3.3.2(d)].

Figure 3.3.2(a): Variation in patient survival at 1-year among PD centres adjusted for age and diabetes mellitus, 2013-2022



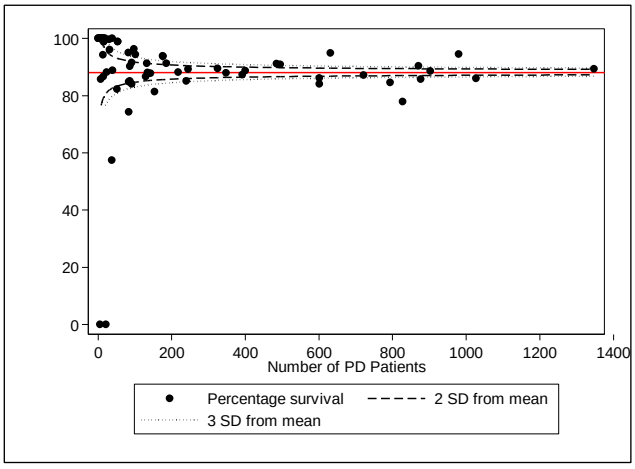
**Horizontal line represents the median % survival among PD centres*

Figure 3.3.2(c): Variation in patient survival at 5-years among PD centres adjusted for age and diabetes mellitus, 2013-2018



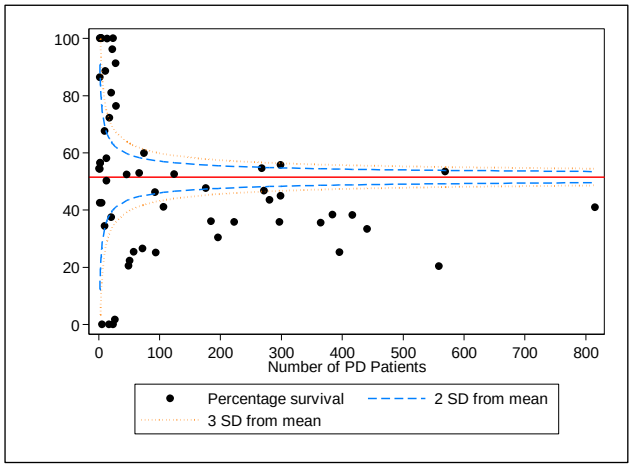
**Horizontal line represents the median % survival among PD centres*

Figure 3.3.2(b): Funnel plot at 1-year among PD centres adjusted for age and diabetes mellitus status, 2013-2022 cohort



**Horizontal line represents the mean % survival among PD centres*

Figure 3.3.2(d): Funnel plot for patient survival at 5-years among PD centres adjusted age and diabetes mellitus, 2013-2018 cohort



**Horizontal line represents the mean % survival among PD centres*

3.4.1: Adjusted hazard ratio for mortality of dialysis patients

The mortality and hazard ratio of the 2004-2023 cohort, adjusted for age, gender, primary diagnosis, year commencing dialysis, dialysis modality, body mass index (BMI), serum albumin, serum cholesterol, diastolic blood pressure, haemoglobin, serum calcium, calcium phosphate product, serum phosphate, viral hepatitis status, and presence of cardiovascular disease were showed in Table 3.4.1.

Patient variables that had significant impact on mortality were age, gender, primary kidney disease, year starting dialysis, dialysis modality, BMI, diastolic blood pressure and the presence cardiovascular disease. The biochemical variables associated with a significant risk factor for mortality were serum albumin, serum cholesterol, haemoglobin, calcium, calcium phosphate product, and phosphate.

Diastolic blood pressure [Figure 3.4.1(a)], low haemoglobin [Figure 3.1.1(b)], low serum phosphate [Figure 3.4.1(c)] was of higher risk for mortality.

Female patients have 20% lower risk of mortality compared to their male counterpart while patients with diabetes mellitus as the primary aetiology of kidney failure has the highest mortality risk when compared to other causes of end stage kidney failure. Patients initiating dialysis in this era (2019-2023) has the highest risk of mortality compared to those who started dialysis in the earlier years (2004-2008).

PD patients have a 5% higher mortality risk compared to HD patients.

Table 3.4.1: Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality (2004-2023)

Factors	n	Hazard ratio	95% CI	P-value
Age (years)				
Age 1-14	892	0.85	(0.71, 1.019)	0.08
Age 15-24	3,359	0.80	(0.722, 0.881)	<0.001
Age 25-34 (ref*)	8,199	1.00		
Age 35-44	15,176	1.50	(1.419, 1.595)	<0.001
Age 45-54	30,753	2.17	(2.053, 2.291)	<0.001
Age 55-64	41,660	2.97	(2.813, 3.142)	<0.001
Age >=65	36,589	4.14	(3.912, 4.385)	<0.001
Gender				
Male (ref*)	75,058	1.00		
Female	61,570	0.80	(0.78, 0.811)	<0.001
Primary diagnosis				
Unknown primary	14,749	1.23	(1.143, 1.321)	<0.001
Diabetes mellitus	82,283	1.74	(1.626, 1.859)	<0.001
GN/SLE (ref*)	4,647	1.00		
Polycystic kidney	906	0.94	(0.812, 1.092)	0.429
Obstructive nephropathy	1,855	1.25	(1.122, 1.389)	<0.001
Toxic nephropathy	739	1.25	(1.093, 1.436)	0.001
Hypertension	28,010	1.21	(1.126, 1.292)	<0.001
Others	3,448	1.37	(1.251, 1.506)	<0.001
Year start dialysis				
2004-2008 (ref*)	13,775	1.00		
2009-2013	27,460	2.05	(1.937, 2.173)	<0.001
2014-2018	38,668	3.33	(3.138, 3.527)	<0.001
2019-2023	46,701	4.37	(4.108, 4.641)	<0.001

Factors	n	Hazard ratio	95% CI	P-value
Modality				
HD (ref*)	117,324	1.00		
PD	19,304	0.79	(0.764, 0.818)	<0.001
BMI				
BMI <18.5	5,148	1.34	(1.278, 1.41)	<0.001
BMI 18.5-25 (ref*)	55,620	1.00		
BMI 25-30	56,544	1.07	(1.053, 1.097)	<0.001
BMI >=30	19,316	0.94	(0.917, 0.971)	<0.001
Albumin (g/L)				
<25	4,010	7.04	(6.639, 7.463)	<0.001
25-<30	8,960	4.12	(3.943, 4.301)	<0.001
30-<35	25,580	2.42	(2.353, 2.499)	<0.001
35-<40	62,590	1.55	(1.514, 1.59)	<0.001
>=40 (ref*)	35,488	1.00		
Serum cholesterol (mmol/L)				
<3.5	22,429	1.00	(0.974, 1.023)	0.893
3.5-<5.2 (ref*)	92,642	1.00		
5.2-<6.2	14,992	1.11	(1.079, 1.148)	<0.001
>=6.2	6,565	1.35	(1.285, 1.409)	<0.001
Diastolic BP (mmHg)				
<70	25,470	1.01	(0.977, 1.035)	0.718
70-<80	53,296	0.96	(0.938, 0.983)	0.001
80-<90 (ref*)	42,759	1.00		
90-<100	12,500	1.19	(1.145, 1.236)	<0.001
>=100	2,603	1.69	(1.565, 1.827)	<0.001
Haemoglobin (g/dL)				
<10	57,736	1.58	(1.547, 1.61)	<0.001
10-<12 (ref*)	69,572	1.00		
>=12	9,320	0.92	(0.889, 0.962)	<0.001
Serum calcium (mmol/L)				
<2.1	37950	1.05	(1.028, 1.075)	<0.001
2.1-<=2.37 (ref*)	81512	1.00		
>2.37	17166	0.92	(0.892, 0.95)	<0.001
Calcium Phosphate product (mmol2/L2)				
<3.5	51,485	0.90	(0.871, 0.92)	<0.001
3.5-<4.5 (ref*)	51,703	1.00		
4.5-<5.5	21,238	0.94	(0.906, 0.976)	0.001
>=5.5	7,159	1.09	(1.02, 1.162)	0.01
Serum Phosphate (mmol/L)				
<0.8	858	1.96	(1.741, 2.201)	<0.001
0.8-<1.3 (ref*)	17,997	1.00		
1.3-<1.8	62,543	0.89	(0.867, 0.921)	<0.001
1.8-<2.2	37,037	0.86	(0.827, 0.901)	<0.001
>=2.2	18,193	0.93	(0.876, 0.992)	0.027
HBsAg				
Negative (ref*)	94,256	1.00		
Positive	1,975	1.08	(1.015, 1.146)	0.015
Anti-HCV				
Negative (ref*)	94,608	1.00		
Positive	1,050	1.16	(1.072, 1.256)	<0.001
Cardiovascular disease (CVD)				
No CVD (ref*)	128,576	1.00		
CVD	8,052	1.05	(1.016, 1.093)	0.005

Figure 3.4.1(a): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by diastolic blood pressure (2004-2023 cohort)

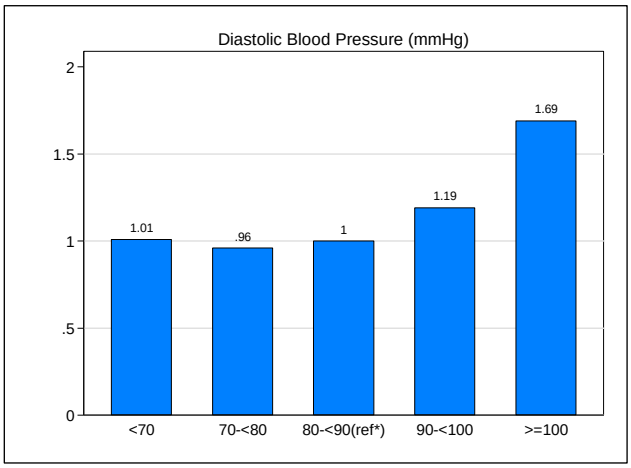


Figure 3.4.1(b): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by haemoglobin (2004-2023 cohort)

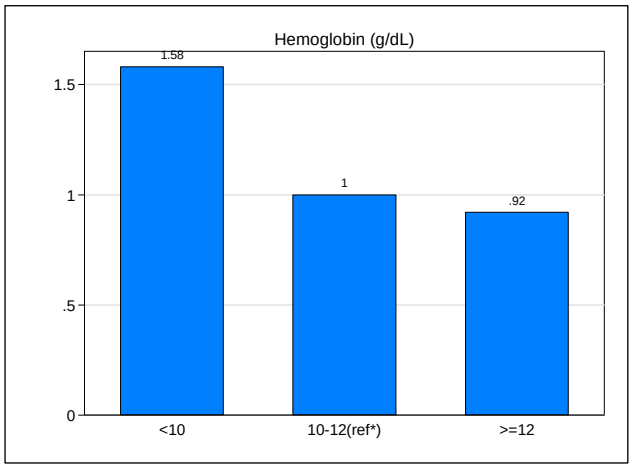


Figure 3.4.1(c): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by serum phosphate (2004-2023 cohort)

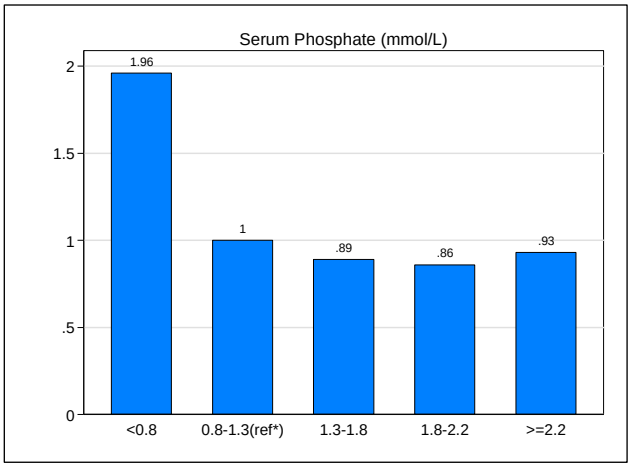
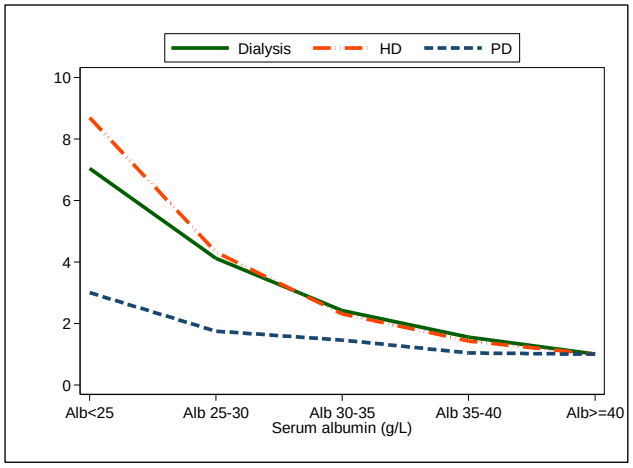


Figure 3.4.1(d): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by serum albumin (2004-2023 cohort)



3.4.2: Adjusted hazard ratio for mortality of haemodialysis patients

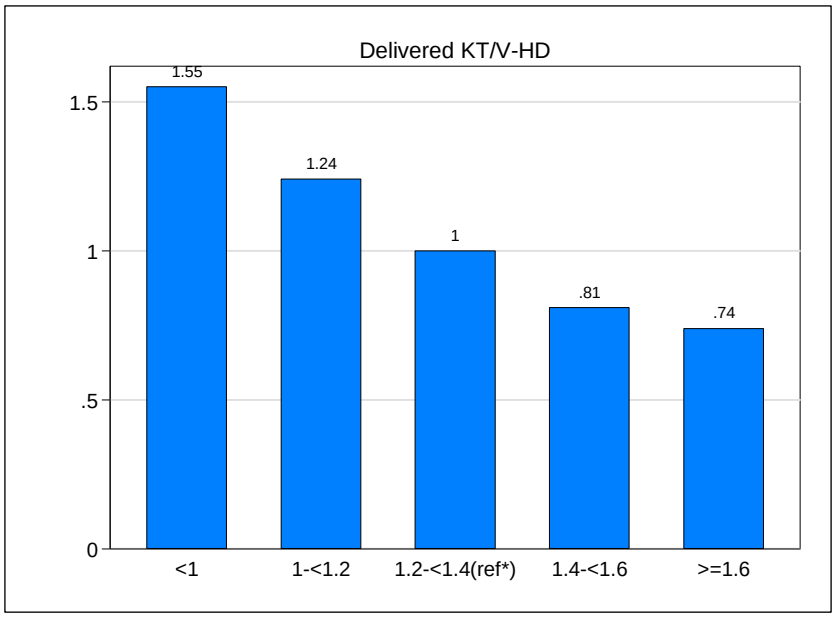
The adjusted hazard ratio for mortality of haemodialysis patients [Table 3.4.2] demonstrated identical pattern with the whole cohort of 2004-2023 dialysis patients since about 90% of the dialysis population consisted of haemodialysis patients. The dose of dialysis treatment (Kt/V) and patient mortality appeared to be inversely proportionate [Figure 3.4.2].

Table 3.4.2: Adjusted hazard ratio for mortality of HD patients [ITT analysis] (2004-2023 cohort)

Factors	n	Hazard ratio	95% CI	P-value
Age (years)				
Age 1-14	204	1.03	(0.723, 1.459)	0.882
Age 15-24	2,143	0.79	(0.689, 0.913)	0.001
Age 25-34 (ref*)	6,364	1.00		
Age 35-44	12,687	1.53	(1.419, 1.66)	<0.001
Age 45-54	26,781	2.23	(2.076, 2.406)	<0.001
Age 55-64	36,514	3.12	(2.901, 3.366)	<0.001
Age >=65	32,631	4.39	(4.066, 4.741)	<0.001
Gender				
Male (ref*)	64,908	1.00		
Female	52,416	0.88	(0.856, 0.905)	<0.001
Primary diagnosis				
Unknown primary	12,856	1.20	(1.087, 1.324)	<0.001
Diabetes mellitus	71,636	1.74	(1.584, 1.903)	<0.001
GN/SLE (ref*)	3,267	1.00		
Polycystic kidney	798	1.00	(0.831, 1.192)	0.957
Obstructive nephropathy	1,491	1.23	(1.064, 1.419)	0.005
Toxic nephropathy	605	1.26	(1.047, 1.523)	0.015
Hypertension	24,037	1.22	(1.113, 1.343)	<0.001
Others	2,634	1.36	(1.202, 1.546)	<0.001
Year start dialysis				
2004-2008 (ref*)	12,256	1.00		
2009-2013	24,430	2.10	(1.947, 2.261)	<0.001
2014-2018	33,612	3.64	(3.368, 3.924)	<0.001
2019-2023	38,878	5.48	(5.06, 5.941)	<0.001
BMI				
BMI <18.5	4,106	1.46	(1.369, 1.556)	<0.001
BMI 18.5-25 (ref*)	47,498	1.00		
BMI 25-30	17427	0.93	(0.905, 0.957)	<0.001
BMI >=30	48,293	0.84	(0.805, 0.867)	<0.001
Serum albumin (g/L)				
<25	1,658	8.69	(7.848, 9.612)	<0.001
25-<30	4,752	4.32	(4.067, 4.597)	<0.001
30-<35	18545	2.31	(2.22, 2.396)	<0.001
35-<40	58180	1.43	(1.385, 1.472)	<0.001
>=40 (ref*)	34,189	1.00		
Serum cholesterol (mmol/L)				
<3.5	20,819	1.04	(1.012, 1.077)	0.007
3.5-<5.2 (ref*)	81,129	1.00		
5.2-<6.2	11394	1.23	(1.176, 1.279)	<0.001
>=6.2	3,982	1.51	(1.408, 1.611)	<0.001

Factors	n	Hazard ratio	95% CI	P-value
Kt/V				
<1	4,465	1.55	(1.468, 1.629)	<0.001
1-<1.2	10,445	1.24	(1.19, 1.285)	<0.001
1.2-<1.4 (ref*)	21488	1.00		
1.4-<1.6	15,654	0.81	(0.785, 0.842)	<0.001
Diastolic BP (mmHg)				
<70	23,655	0.99	(0.951, 1.025)	0.489
70-<80	46,407	0.94	(0.911, 0.969)	<0.001
80-<90 (ref*)	34663	1.00		
90-<100	10,339	1.17	(1.114, 1.234)	<0.001
>=100	2,260	1.69	(1.53, 1.872)	<0.001
Haemoglobin (g/dL)				
<10	50308	1.74	(1.692, 1.783)	<0.001
10-<12 (ref*)	59513	1.00		
>=12	7503	0.93	(0.884, 0.982)	0.008
Serum calcium (mmol/L)				
<2.1	31329	1.09	(1.056, 1.121)	<0.001
2.1-<=2.37 (ref*)	71,224	1.00		
>2.37	14,771	0.98	(0.941, 1.02)	0.319
Calcium Phosphate product ($mmol^2/L^2$)				
<3.5	43,642	0.97	(0.939, 1.011)	0.168
3.5-<4.5 (ref*)	47252	1.00		
4.5-<5.5	19552	0.98	(0.937, 1.032)	0.486
>=5.5	6,878	1.15	(1.06, 1.255)	0.001
Serum Phosphate (mmol/L)				
<0.8	644	1.64	(1.374, 1.964)	<0.001
0.8-<1.3 (ref*)	13,845	1.00		
1.3-<1.8	53644	0.85	(0.818, 0.888)	<0.001
1.8-<2.2	33,122	0.86	(0.81, 0.909)	<0.001
>=2.2	16,069	0.87	(0.804, 0.947)	0.001
HBsAg				
Negative (ref*)	81,645	1.00		
Positive	1,713	1.08	(0.996, 1.161)	0.063
Anti-HCV				
Negative (ref*)	82,037	1.00		
Positive	878	1.18	(1.062, 1.306)	0.002
Cardiovascular disease (CVD)				
No CVD (ref*)	110,618	1.00		
CVD	6,706	1.05	(1.002, 1.104)	0.043

Figure 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality by Kt/V (2004-2023 cohort)



3.4.3: Adjusted hazard ratio for mortality of peritoneal dialysis patients

The adjusted hazard ratio for peritoneal dialysis patients [Table 3.4.3] showed some similarity to the whole cohort of 2014-2023 dialysis patients. Patients with diabetes mellitus as their primary kidney disease fare worst compared to others. A 'U curve' phenomenon is seen for diastolic blood pressure and haemoglobin levels.

Table 3.4.3: Adjusted hazard ratio for mortality of PD patients [ITT analysis] (2004-2023 cohort)

Factors	n	Hazard ratio	95% CI	P-value
Age (years)				
Age 1-14	688	0.73	(0.569, 0.947)	0.018
Age 15-24	1,216	0.82	(0.68, 0.991)	0.04
Age 25-34 (ref*)	1,835	1.00		
Age 35-44	2,489	1.42	(1.24, 1.634)	<0.001
Age 45-54	3,972	1.95	(1.711, 2.217)	<0.001
Age 55-64	5,146	2.53	(2.217, 2.883)	<0.001
Age >=65	3,958	3.40	(2.966, 3.903)	<0.001
Gender				
Male (ref*)	10,150	1.00		
Female	9,154	0.85	(0.807, 0.903)	<0.001
Primary diagnosis				
Unknown primary	1,893	1.40	(1.177, 1.665)	<0.001
Diabetes mellitus	10,647	2.18	(1.868, 2.544)	<0.001
GN/SLE (ref*)	1,380	1.00		
Polycystic kidney	99	0.64	(0.355, 1.144)	0.132
Obstructive nephropathy	364	1.51	(1.175, 1.952)	0.001
Toxic nephropathy	134	1.19	(0.859, 1.661)	0.291
Hypertension	3,973	1.39	(1.191, 1.631)	<0.001
Others	814	1.30	(1.048, 1.605)	0.017
Year start dialysis				
2004-2008 (ref*)	1,519	1.00		
2009-2013	3,030	1.58	(1.232, 2.016)	<0.001
2014-2018	5,056	1.96	(1.547, 2.494)	<0.001
2019-2023	7,823	2.32	(1.819, 2.949)	<0.001
BMI				
BMI <18.5	1,042	1.35	(1.175, 1.552)	<0.001
BMI 18.5-25 (ref*)	8,122	1.00		
BMI 25-30	1,889	1.05	(0.985, 1.11)	0.14
BMI >=30	8,251	0.96	(0.875, 1.043)	0.311
Serum albumin (g/L)				
<25	2,352	3.00	(2.581, 3.492)	<0.001
25-<30	4,208	1.75	(1.515, 2.015)	<0.001
30-<35	7,035	1.46	(1.276, 1.679)	<0.001
35-<40	4,410	1.04	(0.902, 1.199)	0.594
>=40 (ref*)	1,299	1.00		
Serum cholesterol (mmol/L)				
<3.5	1,610	1.03	(0.941, 1.127)	0.518
3.5-<5.2 (ref*)	11,513	1.00		
5.2-<6.2	3,598	1.01	(0.944, 1.088)	0.715
>=6.2	2,583	1.23	(1.137, 1.341)	<0.001

Factors	n	Hazard ratio	95% CI	P-value
Diastolic BP (mmHg)				
<70	1,815	1.54	(1.396, 1.689)	<0.001
70-<80	6,889	1.04	(0.978, 1.107)	0.211
80-<90 (ref*)	8,096	1.00		
90-<100	2,161	1.15	(1.036, 1.268)	0.008
>=100	343	1.27	(0.991, 1.626)	0.058
Haemoglobin (g/dL)				
<10	7,428	1.29	(1.212, 1.365)	<0.001
10-<12 (ref*)	10,059	1.00		
>=12	1,817	1.13	(1.029, 1.247)	0.011
Serum calcium (mmol/L)				
<2.1	6,621	1.15	(1.082, 1.225)	<0.001
2.1-<=2.37 (ref*)	10,288	1.00		
>2.37	2,395	1.03	(0.941, 1.136)	0.488
Calcium Phosphate product ($mmol^2/L^2$)				
<3.5	10,173	1.00	(0.919, 1.084)	0.964
3.5-<4.5 (ref*)	6,020	1.00		
4.5-<5.5	2,318	0.97	(0.862, 1.096)	0.647
>=5.5	793	1.00	(0.813, 1.22)	0.97
Serum Phosphate (mmol/L)				
<0.8	214	2.67	(2.124, 3.347)	<0.001
0.8-<1.3 (ref*)	4,152	1.00		
1.3-<1.8	8,899	0.90	(0.834, 0.964)	0.003
1.8-<2.2	3,915	0.91	(0.807, 1.021)	0.108
>=2.2	2,124	1.09	(0.915, 1.306)	0.326
HBsAg				
Negative (ref*)	12,587	0.00	(0, 0)	<0.001
Positive	275	0.97	(0.811, 1.163)	0.75
Anti-HCV				
Negative (ref*)	12,552	0.00	(0, 0)	<0.001
Positive	154	1.51	(1.226, 1.866)	<0.001
Cardiovascular disease (CVD)				
No CVD (ref*)	17,972	1.00		
CVD	1,332	1.11	(1.007, 1.219)	0.035

3.4.4: Risk Adjusted Mortality Rate by haemodialysis centres

There appeared to be a wide centre variation in risk adjusted mortality rate (RAMR) and the median RAMR for haemodialysis patients by HD centre was 21.3 [Figure 3.4.4(a)]. When adjusted for the size of haemodialysis centres using funnel plot, 554 (61.2%) and 675 (74.6%) of haemodialysis centres were within the 95% CI and 99% CI of the median RAMR respectively [Figure 3.4.4(b)].

Figure 3.4.4(a): Variations in RAMR by HD centre, 2023

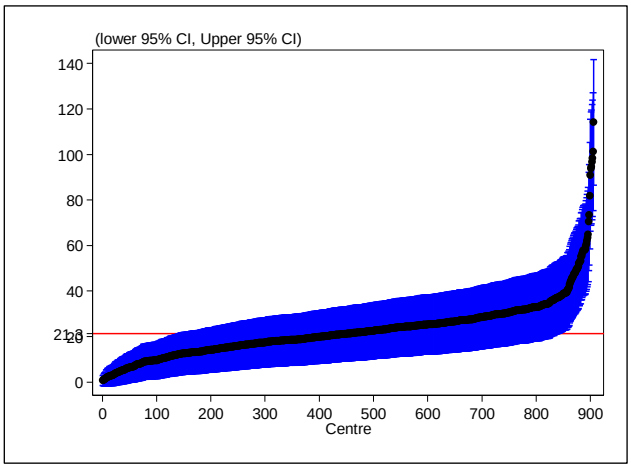
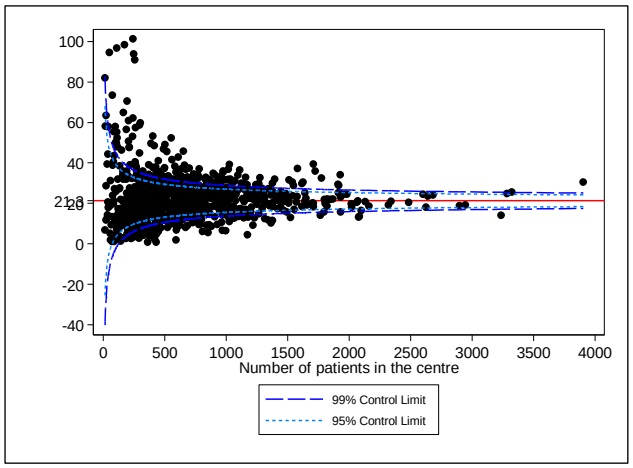


Figure 3.4.4(b): Funnel plot of RAMR by HD centre, 2023



3.4.5: Risk Adjusted Mortality Rate by PD centres

There was a wide variation in RAMR among PD centres with a median risk adjusted mortality rate (RAMR) of 26.5 [Figure 3.4.5(a)]. The variation of the RAMR rate among the various PD centres in this country were rather similar to haemodialysis centres where 34% and 42% of PD centres were within the 95% CI and 99% CI of the median RAMR respectively [Figure 3.4.5(b)]

Figure 3.4.5(a): Variations in RAMR by PD centres, 2023

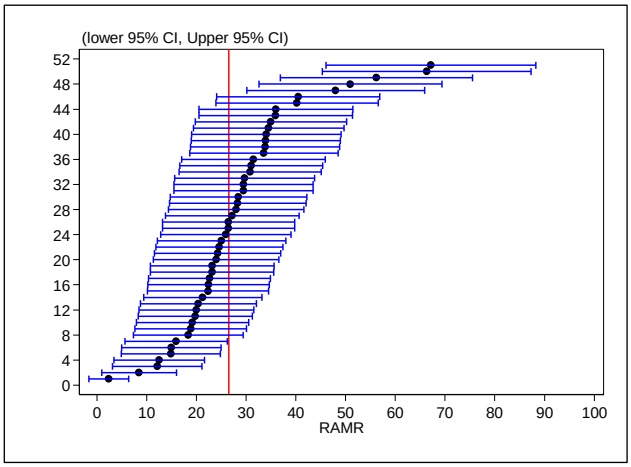
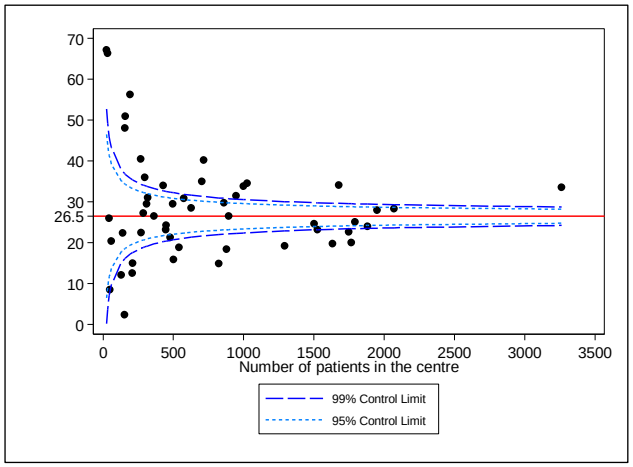


Figure 3.4.5(b): Funnel plot for RAMR by PD centres, 2023



CHAPTER 4

NUTRITIONAL STATUS ON DIALYSIS

Thong Kah Mean
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SECTION 4.1: SERUM ALBUMIN LEVELS ON DIALYSIS

The mean serum albumin level in HD patients in the year 2023 was 38.2 ± 4.6g/L. In the past decade the distribution of serum albumin has remained within a similar range.

Cumulative distribution trends of serum albumin for HD patients from 2014 to 2023 supported this observation (Figure 4.1.1).

Table 4.1.1: Distribution of serum albumin, HD patients, 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30-<35g/L	% patients 35-<40g/L	% patients ≥40g/L
2023	52085	38.2	4.6	38.9	35.8	41.3	5	15	41	39
2022	49663	38.1	4.6	38.8	35.6	41.2	5	16	41	38
2021	49075	38.4	4.6	39	35.9	41.6	4	15	40	41
2020	47363	38.3	4.7	38.9	35.7	41.5	5	16	39	40
2019	44227	38.3	4.7	39	35.8	41.6	5	15	39	41
2018	41300	38.3	4.7	39	35.8	41.5	5	15	39	41
2017	39812	38.1	4.8	38.8	35.5	41.3	5	16	40	39
2016	35913	37.9	4.8	38.7	35.3	41.2	6	17	41	37
2015	33409	38.1	4.8	38.7	35.5	41.3	5	16	41	37
2014	30686	38.3	4.8	38.9	35.8	41.5	5	15	40	40

Figure 4.1.1: Cumulative distribution of serum albumin, HD patients, 2014-2023

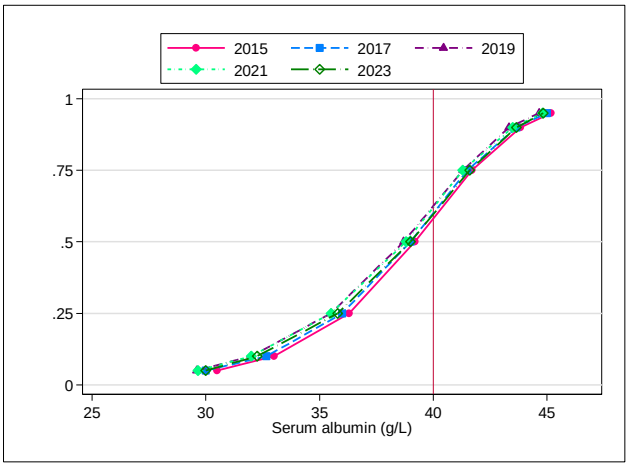
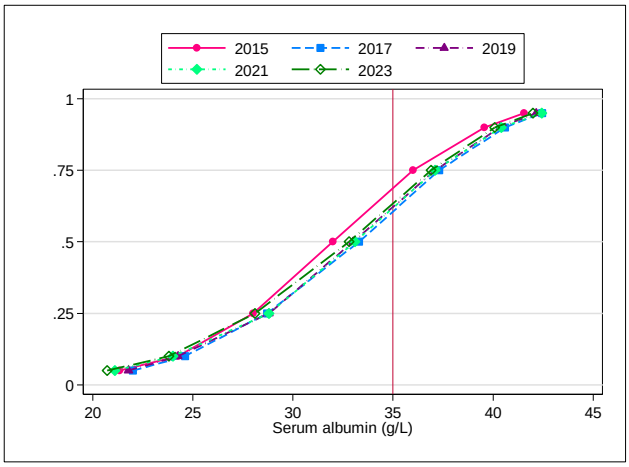


Figure 4.1.2: Cumulative distribution of serum albumin, PD patients, 2014-2023



The mean serum albumin level in PD patients in the year 2023 was lower, 31.6 ± 6.3g/L than previous years. There was only 31% of PD patients who achieved serum albumin levels of ≥35g/L, as compared to 80% among HD patients. Majority of the PD patients (37%) had serum albumin of <30 g/L while 32% had serum albumin between 30-<35 g/dL in 2023. Cumulative distribution trends for serum albumin of PD patients from 2014 to 2023 are shown in Figure 4.1.2.

Table 4.1.2: Distribution of serum albumin, PD patients, 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30-<35g/L	% patients ≥35g/L
2023	7906	31.6	6.3	32	27.8	36	37	32	31
2022	7368	31.7	6.4	32	27.9	36.1	36	31	33
2021	7083	32.2	6.2	32.6	28.6	36.5	32	32	36
2020	6413	32.2	6.3	32.7	28.4	36.5	32	32	36
2019	5840	32.2	6.5	32.6	28	36.9	34	30	36
2018	5357	32.2	6.5	32.7	28.1	36.9	34	31	35
2017	4970	32.6	6.4	33	28.7	37.1	31	30	39
2016	4510	32.4	6.5	33	28.3	37	33	30	37
2015	4191	32.6	6.4	33	28.8	37.1	31	31	38
2014	3594	32.4	6.4	32.9	28.7	36.8	31	33	36

There was a wide variation in serum albumin levels among the 911 HD centres in 2023 (Table 4.1.3 and Figure 4.1.3). The median of HD centres with patients with albumin level ≥40 g/L was 42% in 2023.

Table 4.1.3: Variation in proportion of patients with serum albumin ≥40g/L among HD centres 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	911	0	3	24	42	53	70	92
2022	848	0	2	23	38	53	71	100
2021	811	0	2	24	43	57	73	95
2020	779	0	2	22	44	58	74	100
2019	752	0	3	29	44	58	73	92
2018	735	0	2	29	42	57	72	93
2017	719	0	3	23	39	54	73	92
2016	695	0	2	23	38	50	71	91
2015	672	0	2	24	38	51	70	90
2014	640	0	2	24	41	56	73	92

Figure 4.1.3: Variation in proportion of patients with serum albumin ≥40g/L, HD centres 2023

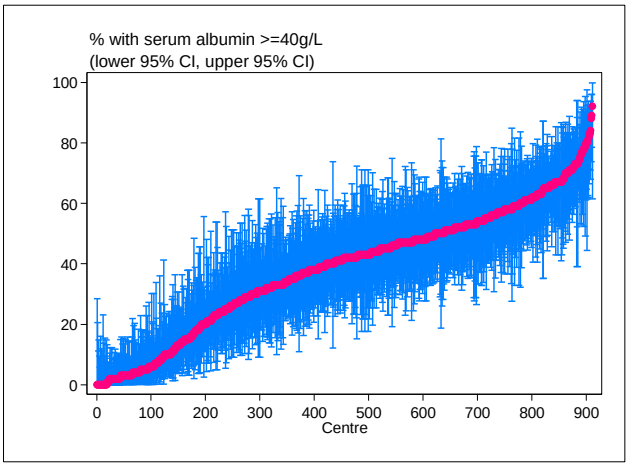
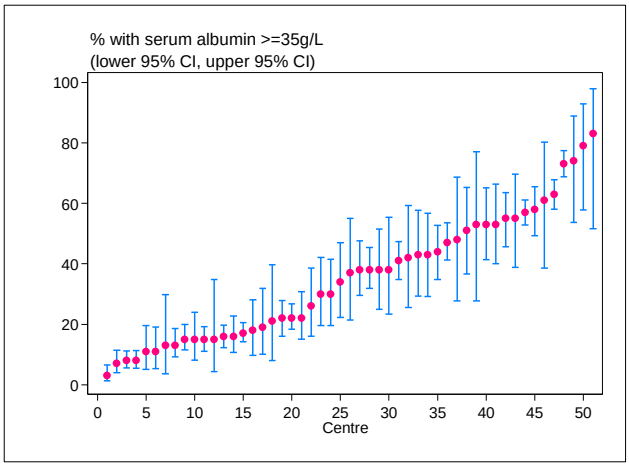


Figure 4.1.4: Variation in proportion of patients with serum albumin ≥35g/L, PD centres 2023



There were 51 PD centres in the year 2023. The median of PD centres with percentage of PD patients achieving serum albumin level ≥35g/L markedly declined from 43.5% in 2014 to 37% in 2023 (Table 4.1.4 and Figure 4.1.4).

Table 4.1.4: Variation in proportion of patients with serum albumin ≥35g/L among PD centres 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	51	3	8	16	37	53	74	83
2022	50	5	9	16	30	52	71	88
2021	47	9	9	17	38	55	67	88
2020	43	6	8	26	38	53	68	92
2019	40	5	7	23.5	39	56.5	74	92
2018	39	0	3	13	40	55	67	76
2017	38	6	6	23	42	54	79	81
2016	37	0	5	28	41	56	70	87
2015	35	0	3	16	41	59	74	76
2014	32	0	8	19	43.5	51.5	82	88

SECTION 4.2: BODY MASS INDEX (BMI) ON DIALYSIS

The mean BMI for HD patients in 2023 was 25.9 ± 5.7 kg/m^2. An increasing trend of BMI was observed for HD patients, with the percentage of HD patients with BMI ≥ 25 kg/m^2 increased from 47% in 2014 to 52% in 2023. The percentage of patients with BMI <18.5 kg/m^2 was 5% in 2023 (Table 4.2.1).

Figure 4.2.1 reflects the increasing BMI trend in HD patients as the curve for 2023 continues moving to the right.

Table 4.2.1: Distribution of BMI, HD patients, 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients ≥25
2023	48212	25.9	5.7	25.2	22.2	28.8	5	43	52
2022	46246	25.9	5.8	25.3	22.2	28.7	5	42	52
2021	46215	26	5.8	25.4	22.3	28.9	5	42	53
2020	44718	25.8	6.2	25.2	22.2	28.7	5	43	52
2019	42426	25.7	6.4	25	22.1	28.5	6	44	50
2018	40009	25.6	6.4	24.9	22	28.3	6	45	50
2017	39054	25.6	7.3	24.9	21.9	28.3	6	46	49
2016	30428	25.4	6.5	24.7	21.8	28.1	6	47	48
2015	28108	25.5	6.9	24.7	21.9	28.1	6	46	48
2014	25691	25.3	5.9	24.7	21.8	28.1	6	47	47

Figure 4.2.1: Cumulative distribution of BMI, HD patients, 2014-2023

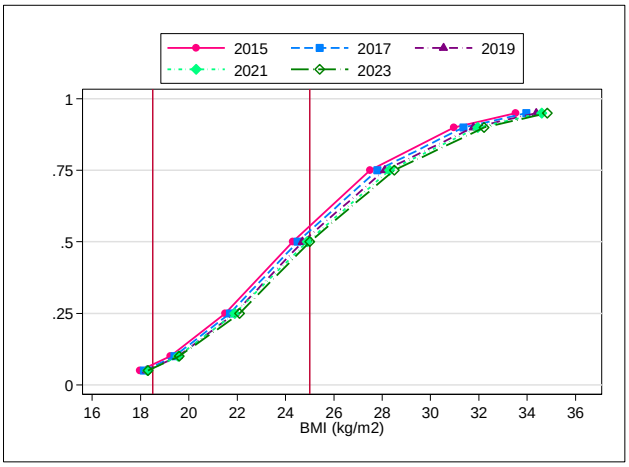
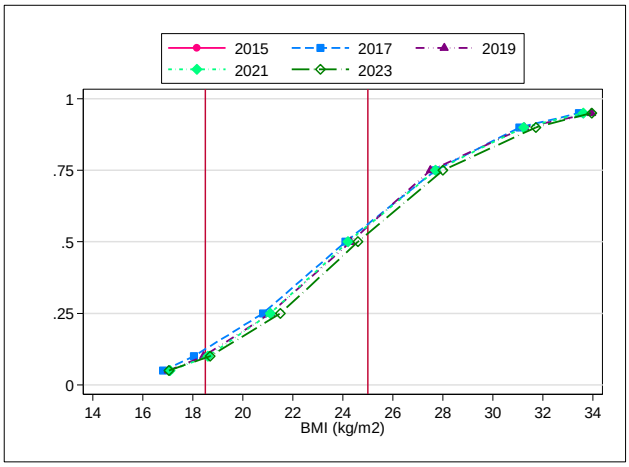


Figure 4.2.2: Cumulative distribution of BMI, PD patients, 2014-2023



The mean BMI for PD patients in 2023 was 25.3 ± 8.7 kg/m^2. Similar to HD patients, the percentage of PD patients with BMI ≥25 kg/m^2 increased from 43% in 2014 to 48% in 2023. The percentage of patients with BMI <18.5 kg/m^2 reduced from 11% in 2014 to 8% in 2023 (Table 4.2.2). The shifting of the cumulative distribution curve for 2023 was to the right (Figure 4.2.2).

Table 4.2.2: Distribution of BMI, PD patients, 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients ≥25
2023	5060	25.3	8.7	24.8	21.7	28.1	8	44	48
2022	5303	25.4	8.8	24.8	21.7	28.1	8	43	48
2021	5292	25.4	6.5	24.9	21.8	28.3	8	43	49
2020	4966	25.1	6.5	24.6	21.5	28	9	45	46
2019	4683	25	5.9	24.6	21.5	28	9	44	47
2018	4304	24.9	6.1	24.5	21.3	27.9	9	45	45
2017	4029	24.8	6.3	24.2	21.1	27.7	10	46	44
2016	3415	24.7	6.8	24.2	21	27.4	10	48	43
2015	3038	24.7	5.8	24.3	21.1	27.5	11	45	44
2014	2689	24.5	5.7	24	21	27.4	11	47	43

Table 4.2.3: Variation in proportion of patients with BMI ≥18.5 and serum albumin ≥40 g/dL among HD centres 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	890	0	2	23	40	52	68	89
2022	828	0	2	22	38	51.5	69	85
2021	793	0	2	23	42	55	72	92
2020	768	0	2	23	42	56	70	90
2019	746	0	2	27	43	57	71	86
2018	725	0	3	28	41	55	69	89
2017	717	0	3	23	38	52	69	94
2016	627	0	2	22	38	49	69	92
2015	593	0	2	23	37	50	69	84
2014	567	0	3	22	40	55	71	90

Figure 4.2.3: Variation in proportion of patients with BMI ≥18.5 kg/m² and serum albumin ≥40 g/dL among HD centres 2023

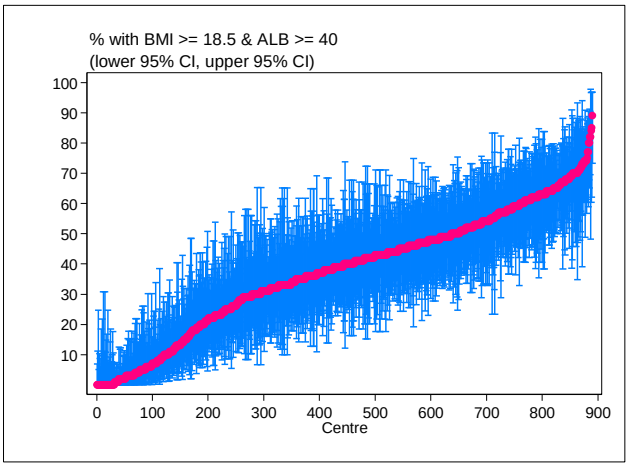


Figure 4.2.4: Variation in proportion of patients with BMI ≥18.5 kg/m² and serum albumin ≥35 g/dL among PD centres 2023

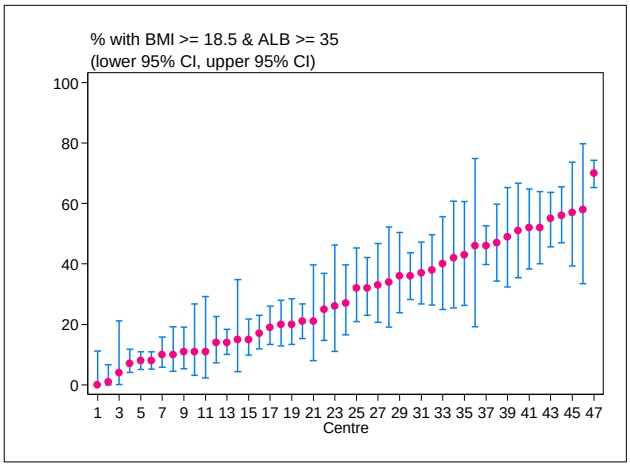


Table 4.2.3 indicates nutritional status in patients from 890 HD centres. Half of the centres achieved the combined nutritional status targets (serum albumin ≥40 g/dL and BMI ≥18.5 kg/m^2) in 40% of their patients in 2023. A wide variation in nutritional status in most centres was observed for 2023 (Figure 4.2.3).

Table 4.2.4 indicates nutritional status of patients in 47 PD centres as assessed by the combined nutritional status targets of BMI ≥18.5 kg/m^2 and serum albumin ≥35 g/dL. Only 27% of patients in half of these centres achieved the combined nutritional status targets in 2023, with wide variation noted among PD centres (Figure 4.2.4).

Table 4.2.4: Variation in proportion of patients with BMI ≥18.5 and serum albumin ≥35 g/dL among PD centres 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	47	0	4	14	27	46	57	70
2022	47	3	6	12	22	44	65	67
2021	46	0	8	15	33	48	65	67
2020	41	0	6	17	33	43	59	69
2019	37	0	3	11	32	47	63	64
2018	37	0	0	7	28	45	64	65
2017	35	0	3	18	36	48	66	70
2016	35	0	0	17	35	52	66	81
2015	31	0	0	12	34	52	62	64
2014	30	0	3	13	38	52	82	82

SECTION 4.3: NUTRITIONAL PARAMETERS

HD patients were older and had significantly better serum albumin, higher BMI, lower serum cholesterol but higher serum creatinine levels compared to PD patients. Both groups had similar haemoglobin levels.

Table 4.3.1: Nutritional parameters between HD and PD patients, 2023

	HD n=52760		PD n=8100		P-Value
	Mean	SD	Mean	SD	
Age	57.4	13.5	50.9	16.1	<0.0001[a]
Albumin (g/dL)	38.2	4.6	31.6	6.3	<0.0001[a]
BMI	25.9	5.7	25.3	8.7	<0.0001[a]
Total Cholesterol (mmol/L)	4.2	1.0	4.7	1.3	<0.0001[a]
Sr Creatinine (µmol/L)	736.1	163.7	721.4	183.9	<0.0001[a]
Haemoglobin	10.3	1.7	10.3	1.7	0.2895

[a] Independent t-test

In HD population, diabetic patients were older compared to non-diabetic patients. Diabetic patients also had significantly higher BMI, but lower serum albumin, total cholesterol, serum creatinine and haemoglobin levels than non-diabetic group.

Table 4.3.2(a): Nutritional parameters between diabetic and non-diabetic HD patients, 2023

	Diabetes n=26019		Non-Diabetes n=26741		P-Value
	Mean	SD	Mean	SD	
Age	60.5	11.3	54.3	14.8	<0.0001[a]
Albumin (g/dL)	37.8	4.7	38.6	4.5	<0.0001[a]
BMI	26.7	5.6	25.1	5.7	<0.0001[a]
Total Cholesterol (mmol/L)	4.1	1.0	4.2	1.0	<0.0001[a]
Sr Creatinine (µmol/L)	712.3	162.7	762.3	160.8	<0.0001[a]
Haemoglobin	10.3	1.7	10.4	1.7	<0.0001[a]

[a] Independent t-test

In the PD group, diabetic patients were also older compared to non-diabetic PD patients. Similar trend was noted as in HD group, in which diabetic patients had higher BMI but lower serum albumin, total cholesterol, serum creatinine than the non-diabetics. However, diabetic PD patients had significantly higher haemoglobin level than non-diabetic patients.

Table 4.3.2(b): Nutritional parameters between diabetic and non-diabetic PD patients, 2023

	Diabetes n=3701		Non-Diabetes n=4399		P-Value
	Mean	SD	Mean	SD	
Age	57.8	11.6	45.1	17.1	<0.0001[a]
Albumin (g/dL)	30.4	6.4	32.5	6.1	<0.0001[a]
BMI	26.9	10.7	24.1	6.5	<0.0001[a]
Total Cholesterol (mmol/L)	4.6	1.2	4.8	1.3	<0.0001[a]
Sr Creatinine (µmol/L)	688.3	182.9	756.5	178.4	<0.0001[a]
Haemoglobin	10.4	1.6	10.2	1.8	<0.0001[a]

[a] Independent t-test

The trend of higher serum albumin and lower BMI with longer dialysis vintage was seen in HD patients (Table 4.3.3a).

Table 4.3.3(a): Distribution of serum albumin and BMI by duration of dialysis among HD patients, 2014-2023

Years	<1		1-<5		5-<10		≥10		P-Value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Albumin (g/dL)	35.77	5.39	38.04	3.82	39.10	3.04	39.59	2.85	0.0001[c]
BMI	25.73	6.60	26.41	5.61	26.19	5.80	24.68	4.59	0.0001[c]

[c] ANOVA

Similar findings were noted in PD population. The longer they were on PD treatment, the higher their serum albumin and lower their BMI (Table 4.3.3b) and both these trends were significant.

Table 4.3.3(b): Distribution of serum albumin and BMI by duration of dialysis among PD patients, 2014-2023

Years	<1		1-<5		5-<10		≥10		P-Value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Albumin (g/dL)	31.63	6.60	32.38	5.55	33.69	4.31	34.22	3.98	0.0001[c]
BMI	25.83	8.99	25.61	9.22	24.29	4.82	22.32	4.41	0.0001[c]

[c] ANOVA

CHAPTER 5

MANAGEMENT OF ANAEMIA IN PATIENTS ON DIALYSIS

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SECTION 5.1: TREATMENT FOR ANAEMIA IN PATIENTS ON DIALYSIS

The use of Erythropoiesis Stimulating Agents (ESAs) has been mostly ≥90% since 2014. Higher percentage (93%) of patients on haemodialysis received ESAs compared to 86% of patients on peritoneal dialysis. ESA subsidy for patients in NGO centres has been introduced by the Ministry of Health since 2009. The percentage of patients receiving blood transfusion have reduced significantly both for HD (8%) and PD (4%) in 2023.

Percentage of patients receiving oral iron was 51% in HD patients and 68% in PD patients respectively. In 2023, 45% of HD patients received parenteral iron compared to 14% in PD patients.

Table 5.1.1: Treatment for anaemia, HD patients 2014-2023

Year	Number of patients	% on ESAs	% received blood transfusion	% on oral iron	% received parenteral iron
2023	52760	93	8	51	45
2022	50402	93	8	46	51
2021	49822	92	8	42	48
2020	47832	93	8	41	46
2019	44779	91	8	44	34
2018	41796	84	8	45	37
2017	40260	88	9	46	39
2016	36505	92	12	52	37
2015	33953	93	13	53	38
2014	31353	92	12	54	38

Table 5.1.2: Treatment for anaemia, PD patients 2014-2023

Year	Number of patients	% on ESAs	% received blood transfusion	% on oral iron	% received parenteral iron
2023	8100	86	4	68	14
2022	7578	85	5	65	16
2021	7181	84	4	58	16
2020	6474	84	6	52	18
2019	5884	85	7	46	16
2018	5389	80	8	48	18
2017	5021	81	8	51	19
2016	4564	84	13	65	15
2015	4235	82	15	67	17
2014	3644	83	18	71	20

In 2023, the percentage of patients on ESAs among HD centres varied. The variation in percentage of patients using ESAs among HD centres at the 5th centile has remained stable for the past 10 years. However, at the 95th centile, the percentage of patients on ESA has remained at 100% over the last 10 years (Table 5.1.3). The median usage of ESAs is at 94% to 95% for the last 10 years. For PD patients at the 5th centile, there have been a great variation in ESA utilisation over the years (18 -76%). (Table 5.1.4).

Table 5.1.3: Variation in Erythropoiesis-Stimulating Agents (ESAs) utilisation (% patients) among HD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	914	59	82	91	95	99	100	100
2022	857	54	81	90	95	98	100	100
2021	818	0	79	89	94	98	100	100
2020	782	51	81	90	94	98	100	100
2019	757	15	67	88	95	99	100	100
2018	739	0	58	80	88	93	100	100
2017	722	0	69	84	90	95	100	100
2016	696	21	80	89	94	98	100	100
2015	671	0	80	90	95	98	100	100
2014	644	63	81	89	94	98	100	100

Figure 5.1.3: Variation in ESAs utilisation (% patients) among HD centres, 2023

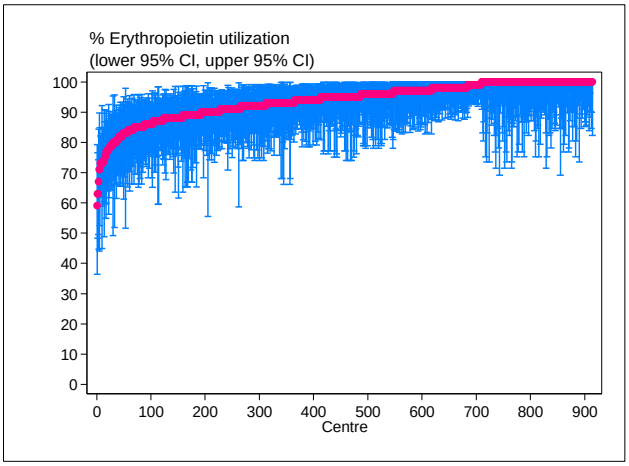


Figure 5.1.4: Variation in ESAs utilisation (% patients) among PD centres, 2023

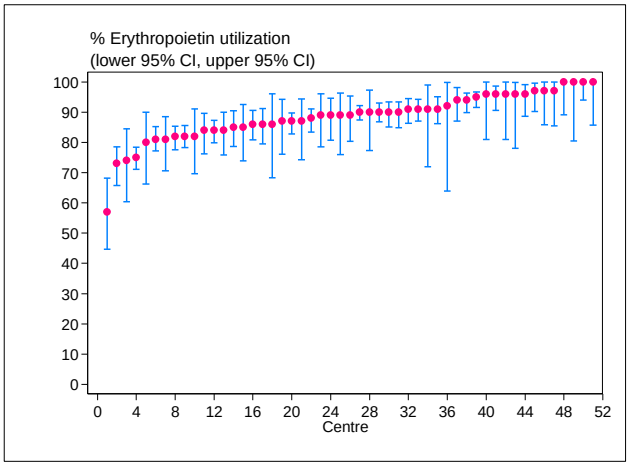


Table 5.1.4: Variation in ESAs utilisation (% patients) among PD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	51	57	74	84	89	95	100	100
2022	50	71	76	82	86.5	93	100	100
2021	47	57	73	82	88	95	100	100
2020	43	66	69	83	90	94	100	100
2019	40	5	18	81.5	89	94	100	100
2018	40	14	29	69	80	88	98.5	100
2017	38	40	64	76	81	90	97	100
2016	37	73	73	80	84	93	100	100
2015	35	69	72	77	87	95	100	100
2014	32	59	64	81	88	94	100	100

Since 2014, the median weekly dose of epoetin for HD patients has remained at 5000 units. In 2023, the minimum and maximum weekly ESA dose was at 2000 IU and 10,000 IU respectively. The median weekly epoetin dose in PD patients was slightly less compared to HD patients at 4000 units per week. In 2023, the minimum and maximum weekly ESA dose for PD patients was at 2000 units and 7000 units respectively. This variation is significantly less as compared to HD patients (Table 5.1.5 & 5.1.6).

The median monthly dose for pegylated epoetin beta was 130mcg and 170mcg for HD and PD patients respectively. Similarly, for darbepoetin alfa, the median monthly dose was 100mcg and 130mcg for HD and PD patients respectively. It is observed that the dose used of long-acting ESA was higher in PD patients compared to HD patients. This is probably due to low usage of parenteral iron in PD patients.

Table 5.1.5(a): Variation in mean weekly Epoetin alfa & beta dose (u/week) among HD centres, 2019-2023

Year	Number of centres	Mean	SD	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	794	5097	1218	2109	3353	4276	4977	5806	7395	9947
2022	751	5066	1241	1971	3385	4228	4895	5711	7295	9611
2021	720	4927	1181	2000	3406	4092	4784	5569	7130	10087
2020	699	4873	1178	1952	3130	4116	4702	5577	7000	9524
2019	741	4828	1113	2000	3226	4073	4680	5500	6842	8864
2018	719	4992	1170	2000	3273	4200	4788	5685	7195	9227
2017	716	5138	1202	1583	3585	4313	4933	5862	7435	9500
2016	687	5275	1347	1143	3597	4423	5070	6027	7551	18000
2015	666	5388	1322	1139	3612	4480	5227	6161	7727	9769
2014	630	5222	1252	1184	3500	4381	5130	5956	7596	9272

Table 5.1.5(b): Variation in mean monthly Pegylated epoetin beta dose (mcg/month) among HD centres, 2019-2023

Year	Number of centres	Mean	SD	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	255	153	64	75	91	114	133	171	280	504
2022	240	150	66	77	90	110	130	170	286	505
2021	223	151	66	66	88	107	129	175	300	480
2020	219	147	63	62	86	107	129	171	263	466
2019	167	132	57	71	84	104	118	142	216	685

Table 5.1.5(c): Variation in mean monthly Darbepoetin alfa dose (mcg/month) among HD centres, 2019-2023

Year	Number of centres	Mean	SD	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	109	102	26	49	62	84	98	118	148	200
2022	100	103	32	50	67	83	94	116	162	255
2021	87	98	29	48	64	79	91	111	146	243
2020	80	94	27	40	52	80	91	109	150	172
2019	51	88	28	45	55	70	83	98	124	218

Figure 5.1.5(a): Variation in mean weekly Epoetin alfa & beta dose (u/week) among HD centres, 2023

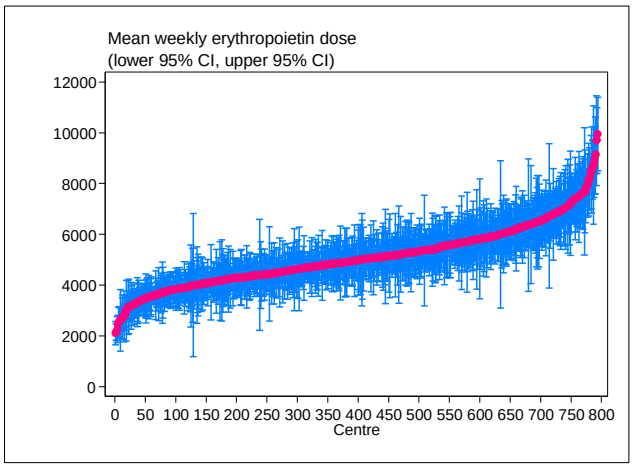


Figure 5.1.5(b): Variation in mean monthly Pegylated epoetin beta dose (mcg/month) among HD centres, 2023

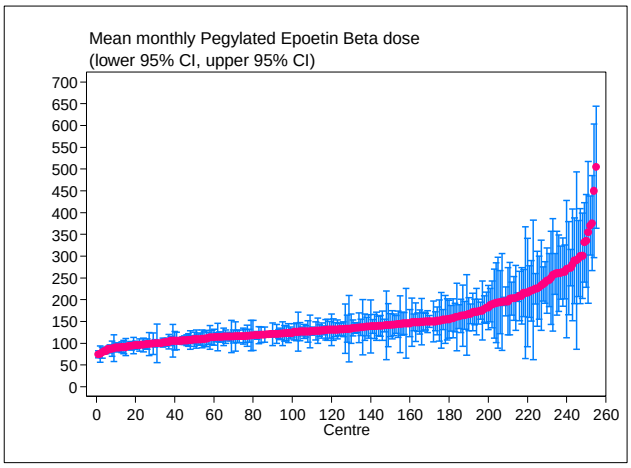


Figure 5.1.5(c): Variation in mean monthly Darbepoetin alfa dose (mcg/month) among HD centres, 2023

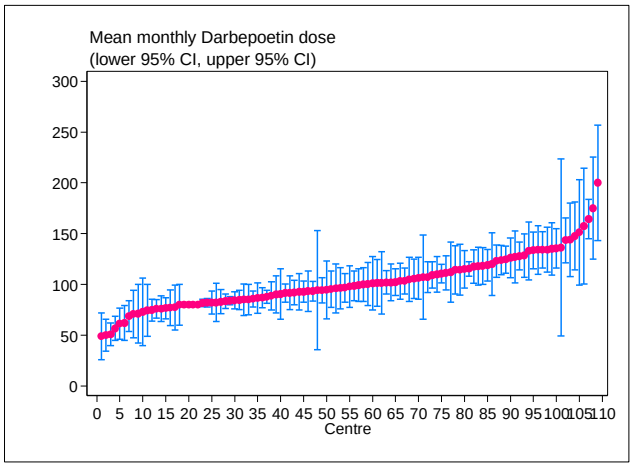


Table 5.1.6(a): Variation in mean weekly Epoetin alfa & beta dose (u/week) among PD centres, 2014-2023

Year	Number of centres	Mean	SD	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	47	4187	995	2240	2694	3478	4089	4842	5904	6909
2022	47	4065	793	2083	2273	3571	4182	4559	5191	5678
2021	44	4042	725	2000	3000	3640	3926	4497	5316	5513
2020	41	4089	793	2500	2900	3700	3917	4704	5594	5671
2019	36	4010	722	2286	2910	3656	3818	4388	5500	5559
2018	35	4248	693	3083	3300	3662	4095	4831	5713	5899
2017	36	4420	829	2200	3250	3904	4338	4939	6160	6293
2016	35	4714	821	3333	3353	4095	4737	5018	6667	6722
2015	34	4707	1075	2000	2875	4114	4610	5380	6465	7057
2014	31	4683	1096	1784	2453	4031	4509	5380	6324	7056

Table 5.1.6(b): Variation in mean monthly Pegylated epoetin beta dose (mcg/month) among PD centres, 2019-2023

Year	Number of centres	Mean	SD	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	34	185	62	77	103	137	171	228	292	304
2022	30	189	70	103	104	130	171	243	323	325
2021	28	181	57	99	101	135	170	226	260	308
2020	24	178	63	98	124	133	156	214	300	380
2019	18	155	40	106	106	123	137	183	239	239

Table 5.1.6(c): Variation in mean monthly Darbepoetin alfa dose (mcg/month) among PD centres, 2019-2023

Year	Number of centres	Mean	SD	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	10	124	31	80	80	98	128	139	180	180
2022	13	119	31	73	73	104	120	135	182	182
2021	12	124	40	64	64	92	125	149	206	206
2020	12	123	53	42	42	86	122	148	229	229
2019	7	100	29	36	36	100	111	118	120	120

Figure 5.1.6(a): Variation in mean weekly Epoetin alfa & beta dose (u/week) among PD centres, 2023

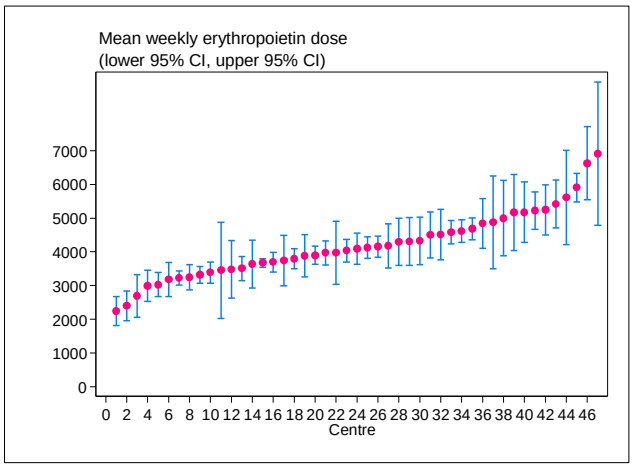


Figure 5.1.6(b): Variation in mean monthly Pegylated epoetin beta dose (mcg/month) among PD centres, 2023

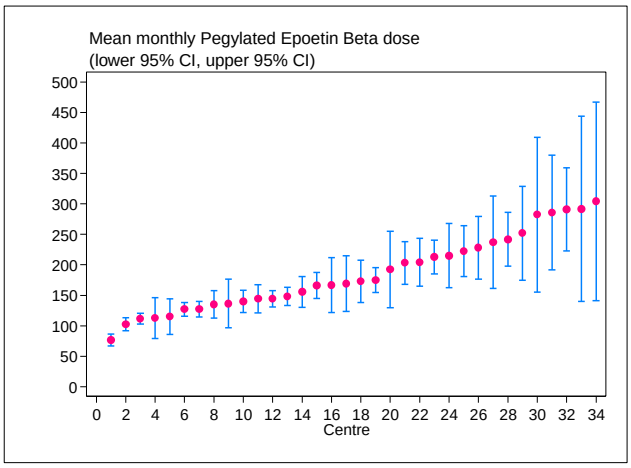
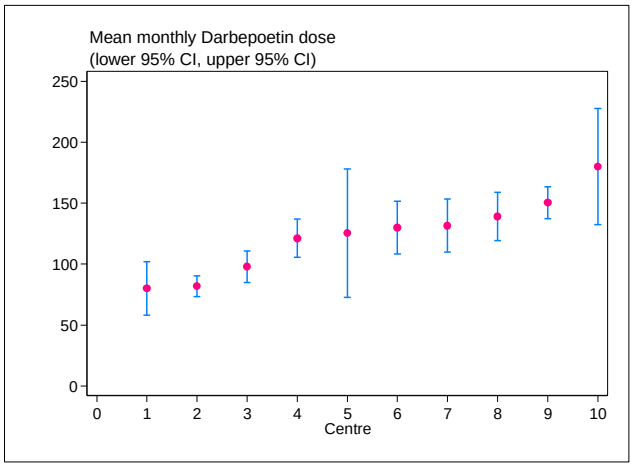


Figure 5.1.6(c): Variation in mean monthly Darbepoetin alfa dose (mcg/month) among PD centres, 2023

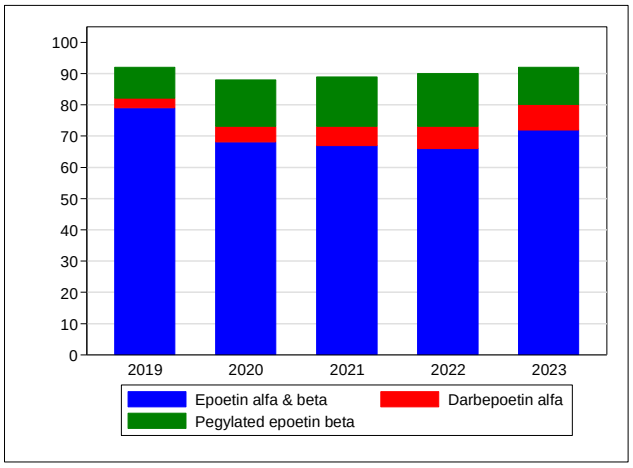


It is observed that the use of short acting ESA initially has shown a reduction from 2019 to 2022 but increased to 72% in 2023. The use of long acting ESA namely Darbepoetin alfa has increased steadily over the years. This is also noted in Pegylated epoetin beta over the past 4 years except in 2023 (Table 5.1.7).

Table 5.1.7: Use of erythropoiesis-stimulating agents in patients receiving dialysis, 2019-2023

Year	Number of patients	% on Epoetin alfa & beta	% Darbepoetin alfa	% Pegylated epoetin beta
2023	61494	72	8	12
2022	59953	66	7	17
2021	58878	67	6	16
2020	56254	68	5	15
2019	52521	79	3	10

Figure 5.1.7: Use of erythropoiesis-stimulating agents in patients receiving dialysis, 2019-2023



The median requirement of blood transfusion in HD and PD centres was at 6% and 4% respectively in 2023. Over the past 10 years, variation in the use of blood transfusion among HD and PD centres has reduced. For the past 5 years, the variation in blood transfusion usage was 0% to 24% in HD patients and 0% to 33% in PD patients. (Table 5.1.8 & 5.1.9).

Table 5.1.8: Variation in use of blood transfusion (% patients) among HD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	914	0	0	3	6	11	23	92
2022	854	0	0	3	6	11	21	55
2021	818	0	0	2	6	11	23	46
2020	781	0	0	3	6	11	24	64
2019	760	0	0	2	6	11	22.5	50
2018	741	0	0	2	6	12	24	87
2017	723	0	0	3	7	14	27	60
2016	696	0	0	6	12	18	33	82
2015	670	0	0	6	12	19	33	80
2014	642	0	0	6	11	19	33	63

Figure 5.1.8: Variation in use of blood transfusion (% patients) among HD centres, 2023

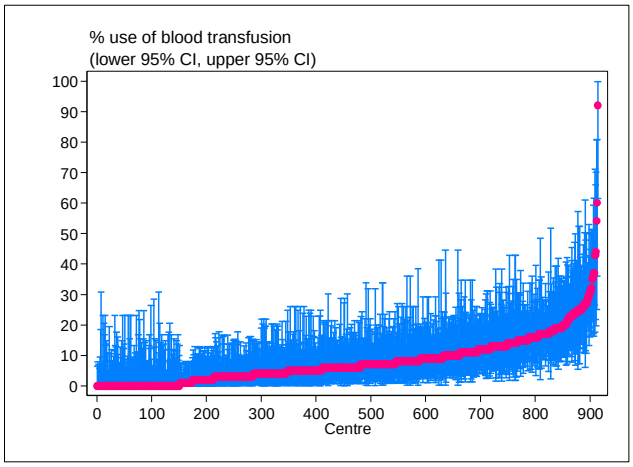


Figure 5.1.9: Variation in use of blood transfusion (% patients) among PD centres, 2023

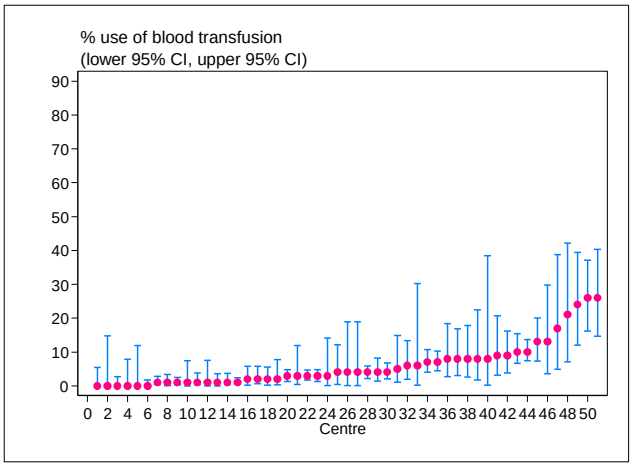


Table 5.1.9: Variation in use of blood transfusion (% patients) among PD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	51	0	0	1	4	8	24	26
2022	50	0	0	2	4	9	33	43
2021	47	0	0	2	3	8	24	40
2020	43	0	0	2	5	8	15	27
2019	40	0	0	2.5	5	8	18	38
2018	39	0	0	2	5	9	23	24
2017	38	0	0	3	4.5	9	26	29
2016	37	0	0	7	10	17	28	29
2015	35	3	3	9	14	17	33	59
2014	31	0	4	10	18	23	39	47

SECTION 5.2: IRON STATUS ON DIALYSIS

The median serum ferritin for HD and PD patients not on ESAs was at 280 ng/ml and 480 ng/ml respectively in 2023. The target ferritin for HD and PD patients is ≥200ng/ml. 59% of HD patients and 80% of PD patients achieved their target (Table 5.2.1 & 5.2.2).

The median serum ferritin for HD and PD patients on ESAs was at 500 ng/ml and 570 ng/ml respectively in 2023. 80% of HD patients and 88% of PD patients achieved their target (Table 5.2.3 & 5.2.4).

80% and 90% of HD and PD patients not on ESA achieved target transferrin saturation of >20% respectively (Table 5.2.5 & 5.2.6). For those on ESA, 83% and 88% of HD and PD patients achieved this target respectively (Table 5.2.7 & 5.2.8).

Table 5.2.1: Distribution of serum ferritin without ESAs, HD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <200 ng/ml	% Patients 200-500 ng/ml	% Patients ≥500 ng/ml
2023	3266	442.3	487.3	276.5	104.3	604.7	41	28	31
2022	3229	415.4	472	247.1	97.3	562.3	44	28	28
2021	3532	424.5	485	247	97.1	580.7	44	27	29
2020	3240	410	441.6	254.1	105.7	566.1	42	29	29
2019	3444	496.7	499.4	343	142.1	678.8	34	30	36
2018	5856	525.9	517.3	358	159.8	722	30	32	38
2017	4328	505.6	495.7	346.3	155	685.4	32	32	36
2016	2486	503.5	523	324.8	136.4	697.2	34	30	36
2015	2043	473.3	494.7	314.4	120.9	642.9	38	28	35
2014	1954	460.1	468.8	312	121.7	643	38	29	34

Figure 5.2.1: Cumulative Distribution of serum ferritin without ESAs, HD patients 2014-2023

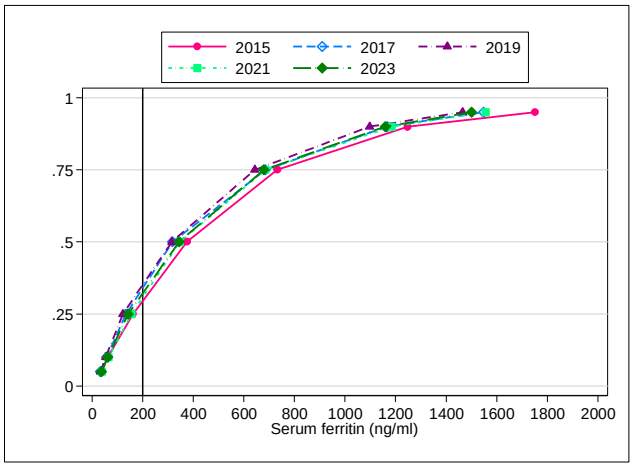


Figure 5.2.2: Distribution of serum ferritin without ESAs, PD patients 2014-2023

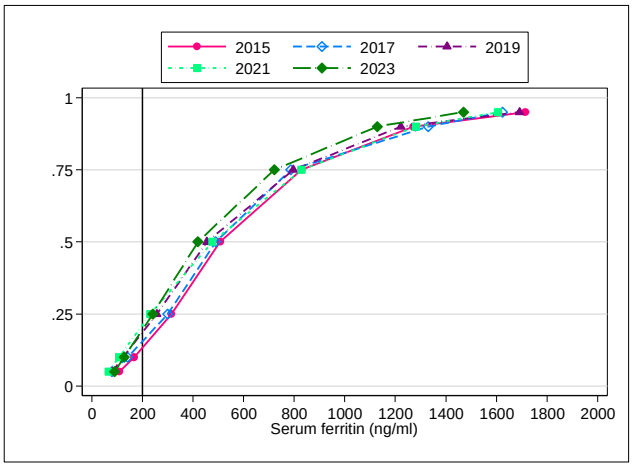


Table 5.2.2: Distribution of serum ferritin without ESAs, PD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <200 ng/ml	% Patients 200-500 ng/ml	% Patients ≥500 ng/ml
2023	891	600.4	471.4	484.8	252.3	839	19	32	48
2022	881	561.7	465	427.7	233.9	748.2	21	36	43
2021	893	596.1	492.5	462	245.7	801.7	20	33	47
2020	851	583.2	481.5	443.5	225.9	784.5	22	33	45
2019	719	541.6	421	419.2	240.3	720.8	20	38	41
2018	913	632	549.7	487	247.8	819.7	20	31	49
2017	785	621.6	557.1	475.8	230.5	829	20	32	48
2016	592	652.5	566.7	515.3	266	826.6	18	30	52
2015	609	606.4	528.9	454.6	256.7	796.2	19	35	46
2014	476	579.5	471.8	440.6	244.5	775.5	17	37	45

Table 5.2.3: Distribution of serum ferritin on ESAs, HD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <200 ng/ml	% Patients 200-500 ng/ml	% Patients ≥500 ng/ml
2023	46813	642.9	545.2	502.7	246.7	867.3	20	30	50
2022	44179	598.8	514.6	465.8	224.9	804.5	22	31	47
2021	43156	613.4	542.9	463	217.8	839.7	23	30	47
2020	41716	606.6	530.2	459.8	217.2	831.8	23	31	47
2019	38013	629	546.8	477.1	227.3	864.7	22	30	48
2018	32453	639.8	548.1	487.9	239.7	876	21	30	49
2017	32036	657.7	550.1	511.2	249	905.4	20	29	51
2016	29249	689.2	572.9	535.6	271.2	946	18	29	53
2015	26775	647.7	529.3	513.2	260	882	19	30	51
2014	24566	654.9	534.7	513.1	266.7	887	18	31	51

Figure 5.2.3: Cumulative distribution of serum ferritin on ESAs, HD patients 2014-2023

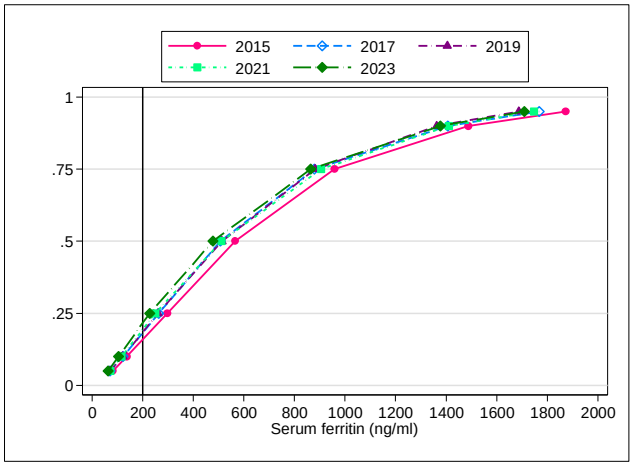


Figure 5.2.4: Cumulative distribution of serum ferritin on ESAs, PD patients 2014-2023

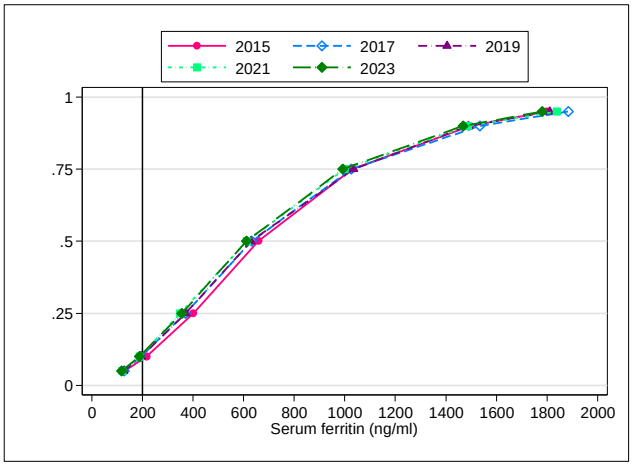


Table 5.2.4: Distribution of serum ferritin on ESAs, PD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <200 ng/ml	% Patients 200-500 ng/ml	% Patients ≥500 ng/ml
2023	5837	703.8	532.7	571.5	328.8	920	12	31	57
2022	5428	705.1	533.3	569.7	314.6	938.8	13	31	56
2021	5180	700.2	521.1	571.8	322.9	942.7	12	31	56
2020	4791	721.8	527.4	587	327.7	994.1	11	30	59
2019	4406	741.2	549	610.8	355.3	992.2	11	29	60
2018	3700	735.7	543.7	605.2	349.7	978.9	11	29	60
2017	3466	750.2	559.1	612.1	348.7	999.5	11	29	60
2016	3230	774.3	572.8	634.5	374.7	1024.5	10	27	62
2015	2946	762.6	540.3	628.7	370.5	1034.6	10	27	62
2014	2604	758.9	548	627.8	368.2	1017.8	11	28	61

Table 5.2.5: Distribution of transferrin saturation without ESAs, HD patients, 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2023	3255	31.1	13.6	29.1	21.7	37.8	79
2022	3252	30.3	13.1	28.4	21.2	36.9	79
2021	3573	30.2	13.4	28.1	21.1	36.5	78
2020	3315	30.1	13.4	27.9	20.9	36.5	78
2019	3416	29.4	13.4	26.9	20.5	35.3	77
2018	5932	29.4	13.9	26.8	20.1	35.3	75
2017	4384	29.6	14.1	26.7	20.2	35.7	76
2016	2629	30.9	14.2	28.4	21.3	37.5	79
2015	2150	31	14.3	28.4	21.3	37.2	79
2014	2053	31.5	14.2	28.7	22.1	38.2	81

Figure 5.2.5: Cumulative distribution of transferrin saturation without ESAs, HD patients 2014-2023

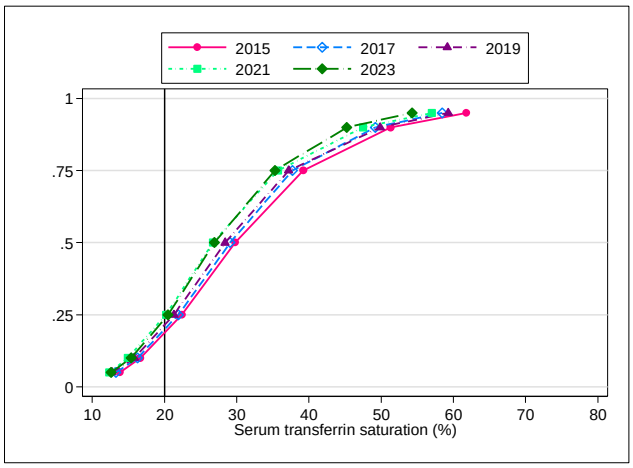


Figure 5.2.6: Cumulative distribution of transferrin saturation without ESAs, PD patients 2014-2023

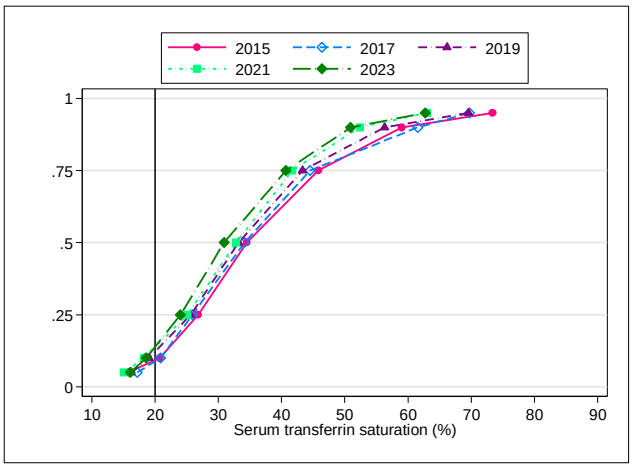


Table 5.2.6: Distribution of transferrin saturation without ESAs, PD patients, 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2023	887	35.3	14	32.9	25.8	42.3	90
2022	900	35.2	14.8	32.3	24.9	42.3	89
2021	910	35.3	14.1	32.9	25.7	41.2	90
2020	870	33.9	14.5	31.4	24.3	40.1	88
2019	717	33.6	13.6	30.9	24	40.7	86
2018	924	33.3	14.2	30.8	23.2	39.5	86
2017	784	34.8	14.7	32.8	25.1	41.7	86
2016	626	37.3	15	34.7	27	43.8	93
2015	649	36.3	16.3	33.2	25.6	43.3	88
2014	517	36.3	16.5	34.2	23.7	44.2	87

Table 5.2.7: Distribution of transferrin saturation on ESAs, HD patients, 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2023	46326	31.7	13.5	29.1	22.5	37.7	83
2022	43922	31.1	13.3	28.6	22.1	37.1	82
2021	43117	30.9	13.5	28.4	21.9	36.9	82
2020	41744	30.3	13.5	27.7	21.3	36.3	79
2019	38308	30.5	13.6	27.8	21.4	36.4	80
2018	32901	30.2	13.3	27.6	21.3	36.1	80
2017	32300	30.3	13.3	27.8	21.4	36.2	80
2016	30639	30.4	13.4	27.8	21.5	36.1	80
2015	27649	30.6	13.6	28	21.6	36.4	81
2014	24808	31.3	13.8	28.6	22.1	37.3	82

Figure 5.2.7: Cumulative distribution of transferrin saturation on ESAs, HD patients 2014-2023

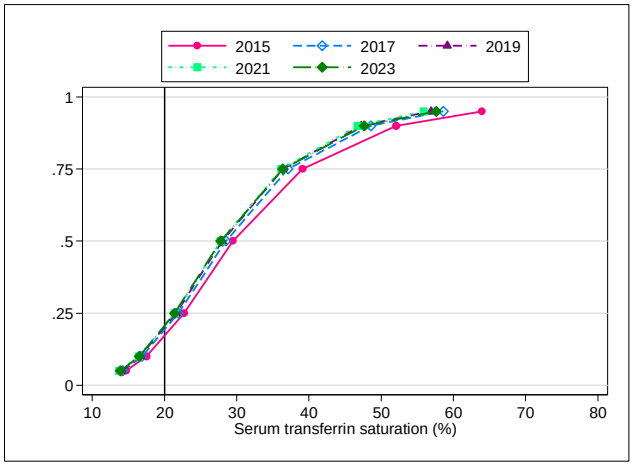


Figure 5.2.8: Cumulative distribution of transferrin saturation on ESAs, PD patients 2014-2023

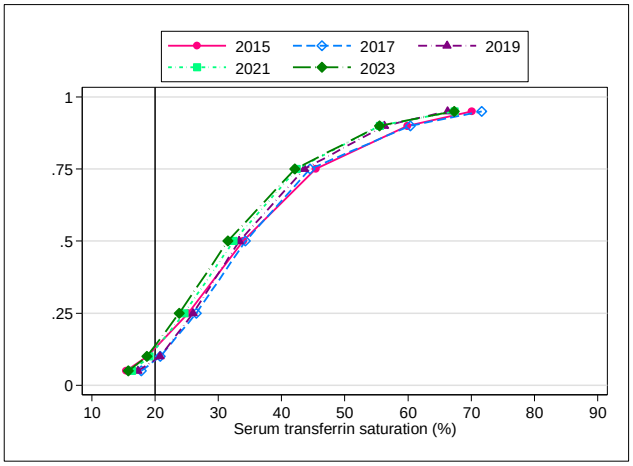


Table 5.2.8: Distribution of transferrin saturation on ESAs, PD patients, 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2023	5844	34.9	14.5	32.3	24.7	42.2	88
2022	5524	35.1	15	32.2	24.7	42	88
2021	5148	35	15	31.8	24.7	41.8	88
2020	4804	34.3	15.1	31.1	23.9	41.5	85
2019	4467	34.8	15.5	31.5	23.8	42.1	87
2018	3818	34.4	15	31.3	24	41.1	87
2017	3417	35.3	15.4	32.4	24.6	42.4	88
2016	3264	36	15.3	33	25.1	43	90
2015	2963	36.4	14.9	33.3	26	43.6	91
2014	2487	36.9	15.8	33.7	25.8	44	92

There was a wide variation in ferritin levels ranging from 200 to 1000 ng/ml between HD centres in 2023. A similar trend was seen in the PD centres, 280 ng/ml to 800 ng/ml (Table 5.2.9(a) & 5.2.10(a)). At the median, the proportion of patients with the serum ferritin 200-500ng/ml was 30% and 34% for HD and PD patients respectively. (Table 5.2.9(b) & 5.2.10(b)).

The median transferrin saturation was 30% for HD and 32% for PD patients. (Table 5.2.9(c) & 5.2.10(c)). The median proportion of patients on ESA with transferrin saturation >20% was 85% for HD patients and 88% in PD patients. (Table 5.2.9(d) & 5.2.10(d)).

Table 5.2.9(a): Variation in serum ferritin among patients on ESAs, HD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	891	72	210.2	368.4	500.7	677.3	1050.8	2201.3
2022	830	69	189.8	322.4	468.1	626.4	908.3	1893.2
2021	788	68.8	190.6	325.1	472	634.3	989.7	1846.2
2020	760	58	185.5	321.6	452.7	616.1	970.3	2066.9
2019	728	47	197.7	335.6	468.4	638.1	1075.3	1952.3
2018	692	55.2	182.9	337.5	476.5	646.3	1044.1	1817
2017	672	42.8	199	363.8	496.8	668.2	1073.2	2345.8
2016	655	105.5	232	389.1	527.6	720.5	1067.6	1638.9
2015	619	62.8	207.4	375	511.1	661.7	923.5	1318
2014	585	124.3	230	368.2	499.3	653.4	968.4	1483.6

Figure 5.2.9(a): Variation in serum ferritin among patients on ESAs, HD centres 2023

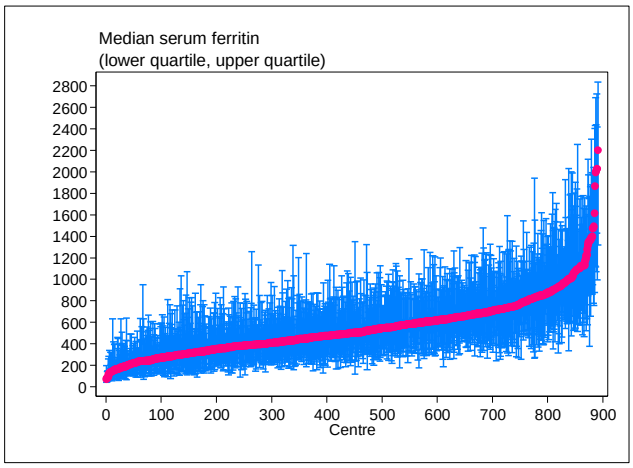


Figure 5.2.9(b): Variation in centres' proportion of patients on ESAs with serum ferritin 200-500ng /ml, HD centres 2023

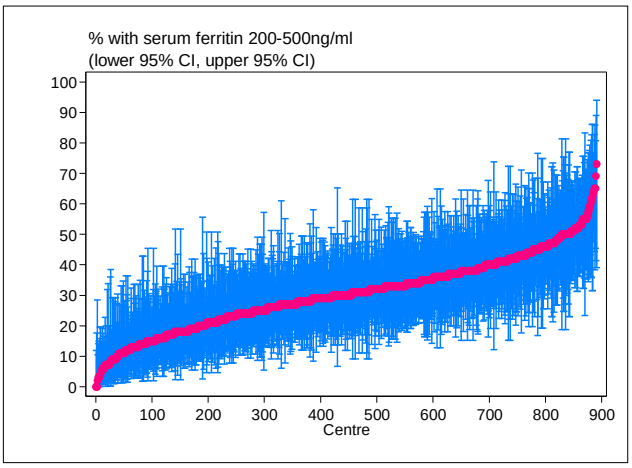


Table 5.2.9(b): Centres' proportion of patients on ESAs with serum ferritin 200-500ng /ml, HD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	891	0	11	22	30	38	51	73
2022	830	0	13	24	32	39	51	80
2021	788	0	12	23	30	38	51	79
2020	760	0	12	23	31	38.5	52	87
2019	728	0	11	22	30	38	50	69
2018	692	0	10	21	30	38	52	72
2017	672	0	10	21	30	37	49	68
2016	655	0	11	21	29	37	50	71
2015	619	3	12	22	30	39	50	69
2014	585	0	11	23	31	39	50	73

Table 5.2.9(c): Transferrin saturation among patients on ESAs, HD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	889	17.6	22.7	26.4	29.3	32.2	37.6	64.7
2022	829	16.8	22.6	25.8	28.6	31.7	36.9	52.6
2021	787	17	22.2	25.7	28.2	30.8	36.4	51.7
2020	762	17.1	21.4	24.8	27.5	30.5	35.4	55.4
2019	730	16.6	21.4	24.9	27.6	30.7	35.9	46.4
2018	696	14.1	20.8	24.8	27.5	30.5	35	44.2
2017	677	16.9	21	25	27.6	30.6	35.3	51.1
2016	661	15.9	21.7	24.8	27.7	30.5	34.6	65.7
2015	621	13.9	21.1	25.1	27.8	30.8	34.9	61
2014	582	17.7	21.6	25.3	28.5	31.6	37.2	69.5

Figure 5.2.9(c): Variation in median transferring saturation among patients on ESAs HD centres 2023

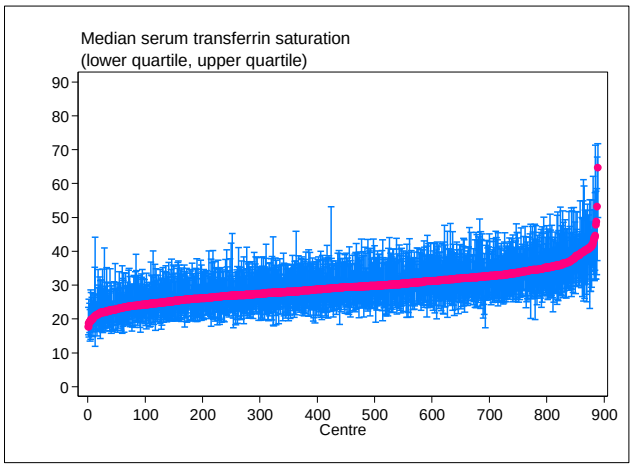


Figure 5.2.9(d): Variation in centres' proportion of patients on ESAs with transferring saturation ≥ 20%, HD centres 2023

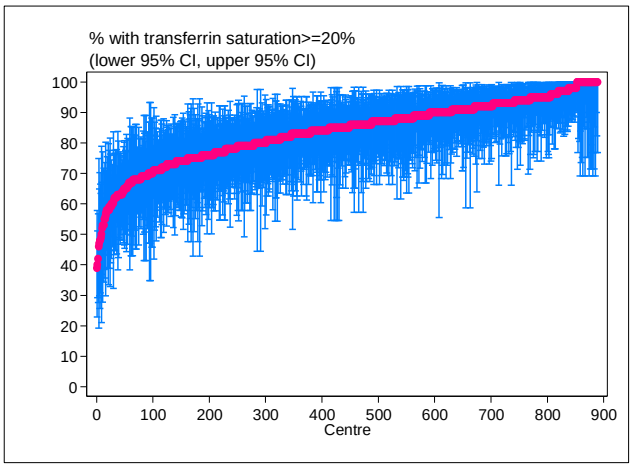


Table 5.2.9(d): Centres' proportion of patients on ESAs with transferrin saturation ≥ 20%, HD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	889	39	63	77	85	91	98	100
2022	829	20	63	76	84	91	97	100
2021	787	23	61	74	83	90	96	100
2020	762	31	57	72	81	89	97	100
2019	730	21	58	72	81.5	89	97	100
2018	696	31	54	71	81	88	97	100
2017	677	26	56	72	81	89	97	100
2016	661	24	57	73	82	89	97	100
2015	621	26	55	73	83	90	98	100
2014	582	37	58	74	84	91	100	100

Table 5.2.10(a): Variation in serum ferritin among patients on ESAs, PD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	48	244.6	277.1	415	509.3	595.4	783.6	1122.9
2022	46	237.8	316.3	409.4	492.1	582.4	779.6	1053
2021	45	298.6	324.5	425.9	501.8	588.2	875.8	1060
2020	41	220.5	297.6	369.1	482.7	622.4	950.6	1207.6
2019	34	251.3	274.7	418.9	577.5	668.6	937.1	1159.1
2018	35	189.1	231.4	450.8	559.1	673.9	858.6	1185.1
2017	33	138.6	283.8	458.2	563.5	663.6	1015	1323.4
2016	34	34	239.5	488.6	563.6	652.7	1192.4	1262.7
2015	33	165.5	404.5	498.4	594	686.7	890.3	1008.4
2014	29	186.7	291	487.1	556	696.1	1216.4	1224.2

Figure 5.2.10(a): Variation in medium serum ferritin among patients on ESAs, PD centres 2023

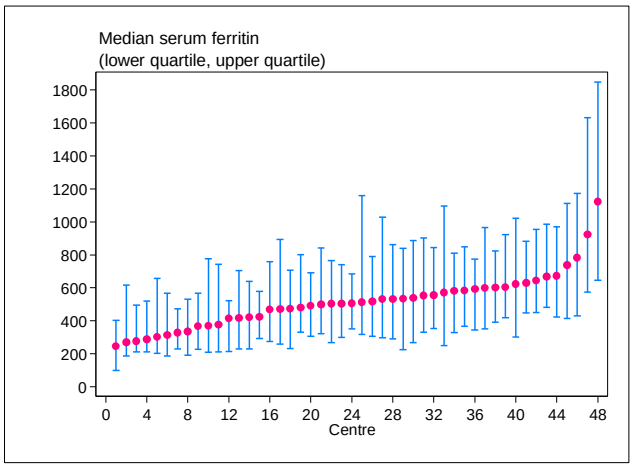


Figure 5.2.10(b): Variation in centres' proportion of patients on ESAs with serum ferritin 200-500ng/ml, PD centres 2023

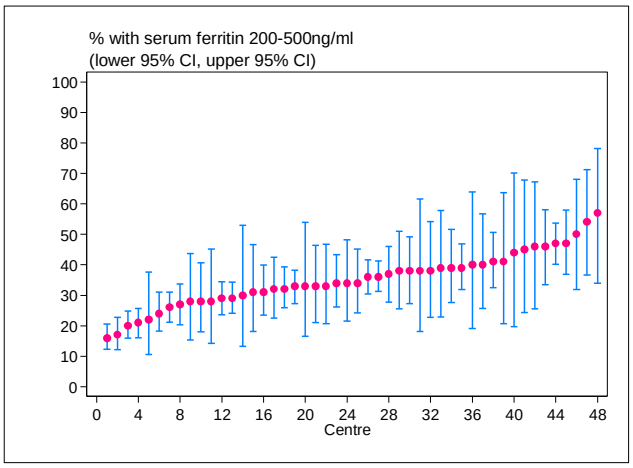


Table 5.2.10(b): Centres' proportion of patients on ESAs with serum ferritin 200-500ng /ml, PD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	48	16	20	29	34	40	50	57
2022	46	12	16	27	33	40	49	52
2021	45	11	20	27	33	41	49	57
2020	41	11	14	26	31	39	48	53
2019	34	5	13	26	32.5	38	51	52
2018	35	15	17	23	29	36	43	50
2017	33	8	9	25	29	36	46	57
2016	34	0	11	24	28.5	34	43	46
2015	33	9	13	23	28	35	50	53
2014	29	10	11	22	28	34	45	45

Table 5.2.10(c): Median transferrin saturation among patients on ESAs, PD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	49	24.3	26.9	29.2	31.5	34.5	38.5	46.6
2022	47	25	26	28.4	31.1	32.7	37.3	49.5
2021	43	25.3	26.9	28.7	31.3	33.6	37.7	48.4
2020	39	22.5	25.1	28.9	30.4	33.2	40.2	47.6
2019	32	24.7	26.7	28.4	29.7	33.5	39.9	45.2
2018	32	24.2	25.2	27.8	31.1	34.6	38.5	40.7
2017	31	23.6	24.3	29.5	30.8	34.4	40.6	41.6
2016	32	23.7	23.8	30.4	32	35.8	43.7	47.8
2015	31	25.5	27.9	29.8	34.5	36.5	38.1	43.6
2014	26	26.3	26.8	29.6	32	36.7	41.1	49.7

Figure 5.2.10(c): Variation in median transferrin saturation among patients on ESAs, PD centres 2023

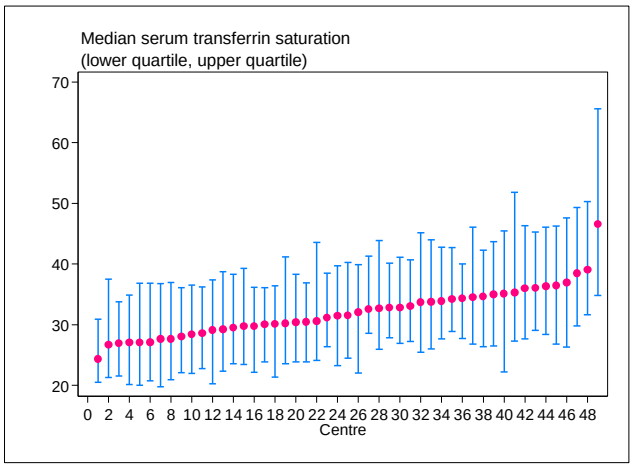


Figure 5.2.10(d): Variation in centres' proportion of patients on ESAs with transferrin saturation ≥20 %, PD centres 2023

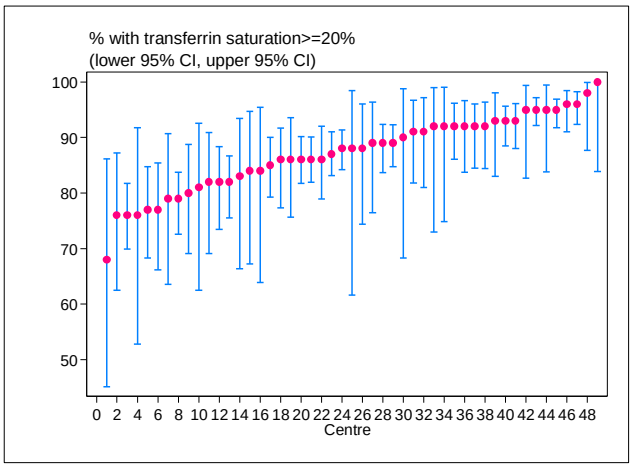


Table 5.2.10(d): Centres' proportion of patients on ESAs with transferring saturation ≥20%, PD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	49	68	76	82	88	92	96	100
2022	47	71	72	81	87	91	99	100
2021	43	73	77	84	88	93	98	98
2020	39	63	64	77	85	91	97	97
2019	32	74	75	80.5	84.5	90	98	100
2018	32	70	71	81.5	87.5	91	97	97
2017	31	65	69	82	88	92	97	98
2016	32	59	67	83.5	90	94	97	100
2015	31	81	82	87	92	96	100	100
2014	26	75	84	87	94	95	100	100

SECTION 5.3: HAEMOGLOBIN OUTCOMES ON DIALYSIS

The median haemoglobin for patients without ESA in HD and PD patients is 12.0 g/dl and 11.5 g/dl respectively (Table 5.3.1 and 5.3.3). 17% and 13% of HD and PD patients not on ESA have haemoglobin <10 g/dl. Percentage of patients with haemoglobin <10g/dl without ESA has reduced over the years.

The median haemoglobin for patients with ESA in HD and PD patients is 10.3 g/dl and 10.1 g/dl respectively. 42% and 47% of HD and PD patients on ESA have haemoglobin <10 g/dl. This trend has remained the same for the past 10 years. Interesting to note that 22% and 19% of HD and PD patients respectively, on ESA have haemoglobin more than 11.5 g/dl.

Table 5.3.1: Distribution of haemoglobin concentration without ESAs, HD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <10g/dL	% Patients 10-<11.5g/dL	% Patients ≥11.5g/dL
2023	3535	11.8	2	12	10.8	13.2	17	21	62
2022	3515	11.7	2	11.9	10.5	13	19	23	58
2021	3860	11.7	2.1	12	10.6	13.1	18	22	60
2020	3549	11.8	2.1	12.1	10.7	13.3	18	20	63
2019	3880	10.7	2.2	10.8	9.2	12.2	36	27	37
2018	6496	10.4	2.1	10.5	8.9	11.9	42	26	32
2017	4937	10.6	2.2	10.6	8.9	12.2	40	24	36
2016	2928	11.6	2.2	11.9	10.1	13.1	24	20	56
2015	2484	11.6	2.1	11.9	10.3	13.1	22	19	59
2014	2429	11.6	2.2	11.9	10.2	13.2	23	21	56

Figure 5.3.1: Cumulative distribution of haemoglobin concentration without ESAs, HD patients 2014-2023

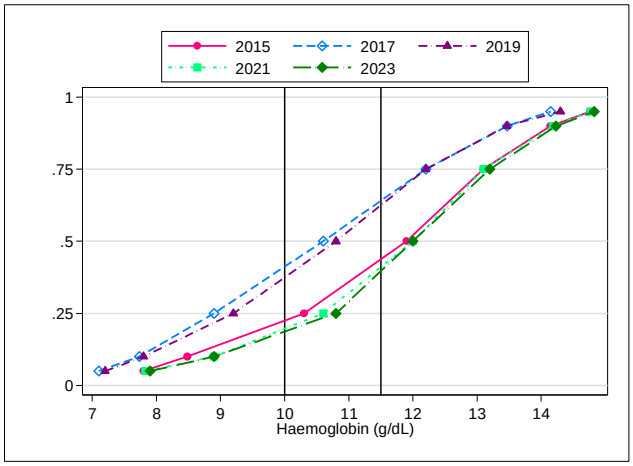


Figure 5.3.2: Cumulative distribution of haemoglobin concentration with ESAs, HD patients 2014-2023

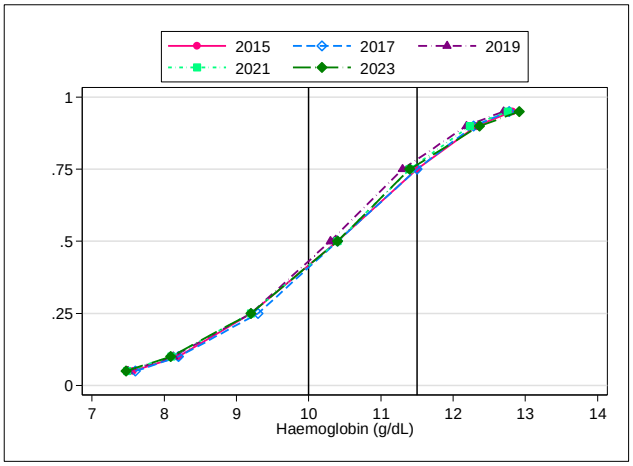


Table 5.3.2: Distribution of haemoglobin concentration with ESAs, HD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <10g/dL	% Patients 10-<11.5g/dL	% Patients ≥11.5g/dL
2023	49125	10.2	1.6	10.3	9.1	11.4	42	36	22
2022	46782	10.2	1.6	10.2	9.1	11.3	44	36	20
2021	45844	10.3	1.6	10.4	9.2	11.4	40	36	24
2020	44180	10.3	1.7	10.5	9.2	11.5	40	35	25
2019	40607	10.3	1.7	10.4	9.2	11.4	41	35	24
2018	35058	10.3	1.6	10.4	9.2	11.4	41	36	23
2017	35101	10.3	1.6	10.4	9.2	11.4	41	36	23
2016	33264	10.3	1.6	10.4	9.2	11.4	41	37	23
2015	31118	10.2	1.6	10.3	9.2	11.3	42	37	22
2014	28574	10.3	1.6	10.4	9.2	11.4	41	37	22

Table 5.3.3: Distribution of haemoglobin concentration without ESAs, PD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <10g/dL	% Patients 10-<11.5g/dL	% Patients ≥11.5g/dL
2023	1083	11.6	1.7	11.5	10.6	12.7	13	36	51
2022	1127	11.5	1.7	11.5	10.5	12.5	14	36	50
2021	1138	11.5	1.7	11.5	10.6	12.6	15	35	50
2020	1003	11.6	1.7	11.6	10.6	12.6	14	33	53
2019	862	11.2	1.8	11.2	10.2	12.3	21	37	42
2018	1054	11.1	1.8	11	10	12.2	25	35	39
2017	933	11.2	1.8	11.2	10.1	12.3	23	34	43
2016	745	11.5	1.7	11.4	10.5	12.6	16	35	48
2015	754	11.3	1.7	11.3	10.3	12.4	18	38	44
2014	610	11.1	1.8	11.1	10	12.1	24	36	40

Figure 5.3.3: Cumulative distribution of haemoglobin concentration without ESAs, PD patients 2014-2023

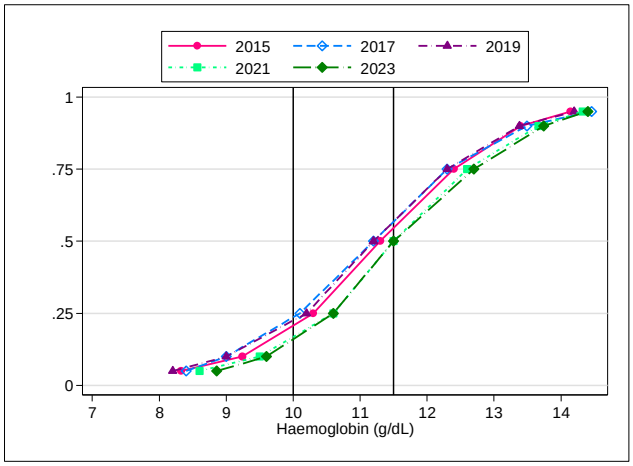


Figure 5.3.4: Cumulative distribution of haemoglobin concentration with ESAs, PD patients 2014-2023

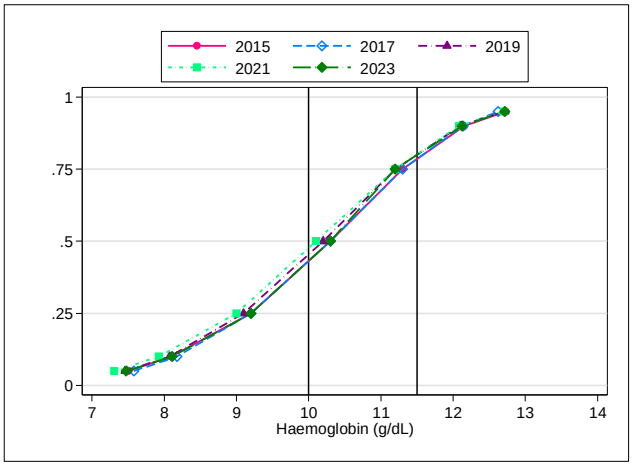


Table 5.3.4: Distribution of haemoglobin concentration with ESAs, PD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <10g/dL	% Patients 10-<11.5g/dL	% Patients ≥11.5g/dL
2023	6900	10.1	1.6	10.1	9	11.2	47	34	19
2022	6401	10.1	1.6	10.1	9	11.2	46	35	19
2021	6013	10.1	1.6	10.2	9.1	11.2	45	36	19
2020	5440	10.2	1.6	10.2	9.1	11.3	44	35	21
2019	4997	10.2	1.6	10.3	9.2	11.2	43	37	20
2018	4323	10.1	1.6	10.2	9.1	11.2	46	36	19
2017	4073	10.1	1.6	10.1	9	11.2	47	35	18
2016	3792	10.1	1.6	10.1	9.1	11.2	46	36	18
2015	3451	10.1	1.6	10.2	9.1	11.2	45	36	19
2014	3016	10.1	1.6	10.2	9.1	11.2	46	35	20

Median haemoglobin for patients on ESA among HD and PD centres was comparable at 10g/dl. (table 5.3.5(a) and 5.3.6(a)). The median proportion of patients with haemoglobin 10-11.5g/dl was 36% for HD centres and 30% for PD centres (table 5.3.5(b) and 5.3.6(b)).

Table 5.3.5(a): Variation in haemoglobin level among patients on ESAs, HD centres 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	911	7.9	9.1	9.9	10.3	10.7	11.2	11.9
2022	852	8	9.1	9.8	10.3	10.6	11.1	11.9
2021	812	8	9.2	10	10.4	10.8	11.2	11.9
2020	780	7.9	9.3	10	10.5	10.9	11.3	11.8
2019	752	7.9	9.1	9.9	10.4	10.8	11.3	12.1
2018	721	8	9.1	9.9	10.3	10.7	11.3	12.3
2017	709	7	9.2	9.9	10.3	10.7	11.2	12
2016	691	7.9	9.2	9.9	10.3	10.7	11.2	11.9
2015	665	8.3	9.3	9.9	10.3	10.7	11.2	12
2014	636	8.2	9.3	9.9	10.3	10.7	11.2	12

Figure 5.3.5(a): Variation in median haemoglobin level among patients on ESAs, HD centres 2023

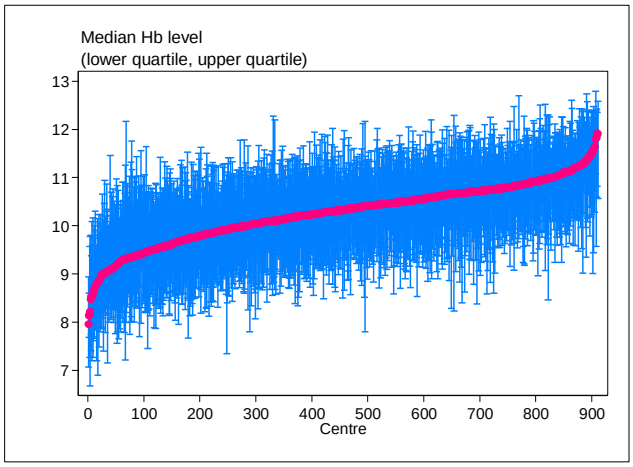
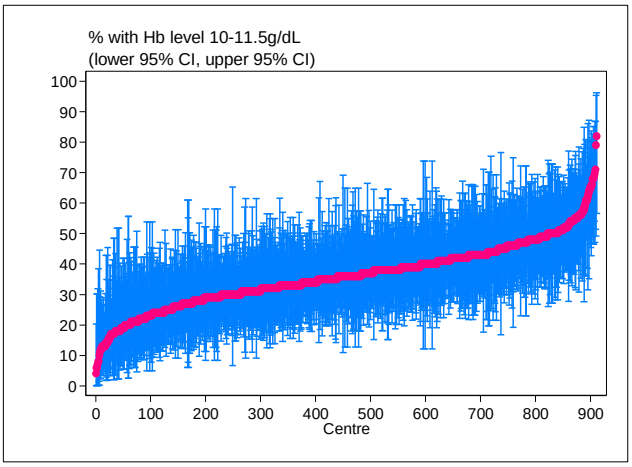


Figure 5.3.5(b): Variation in centres' proportion of patients on ESAs with haemoglobin level 10-11.5g/dL, HD centres 2023



At the median, only 36% and 32% of HD and PD centres respectively, achieved the target haemoglobin of 10 - 11.5 g/dl.

Table 5.3.5(b): Centres' proportion of patients on ESAs with haemoglobin level 10-11.5g/dL, HD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	911	4	19	30	36	43	54	82
2022	852	3	18	28	36	43	53	73
2021	812	0	20	28.5	35	42	53	73
2020	780	0	18	29	35	41	50	78
2019	752	0	17	29	34	41	52	81
2018	721	0	19	29	36	42	54	73
2017	709	0	18	29	36	43	53	76
2016	691	6	20	30	36	43	54	70
2015	665	0	20	29	36	43	54	79
2014	636	0	19	29.5	36	43	54	83

Table 5.3.6(a): Variation in median haemoglobin level among patients on ESAs, PD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	51	9	9.3	9.8	10.1	10.4	10.9	11.4
2022	48	8.5	9.1	9.7	10.1	10.3	11	11.2
2021	47	9.2	9.3	9.9	10.3	10.6	10.9	11.4
2020	43	8.8	9.2	9.6	10.1	10.5	10.9	11.6
2019	36	9	9.3	9.9	10.2	10.4	10.7	11.3
2018	36	8.7	8.8	9.7	9.9	10.4	10.6	10.7
2017	36	8.9	9.1	9.6	10.1	10.4	10.9	10.9
2016	37	8.9	9.2	9.7	10.2	10.4	10.7	11
2015	35	8.6	9.3	9.7	10.1	10.5	10.9	10.9
2014	31	8.6	8.9	9.8	10.2	10.5	10.8	11.1

Figure 5.3.6(a): Variation in median haemoglobin level among patients on ESAs, PD centres 2023

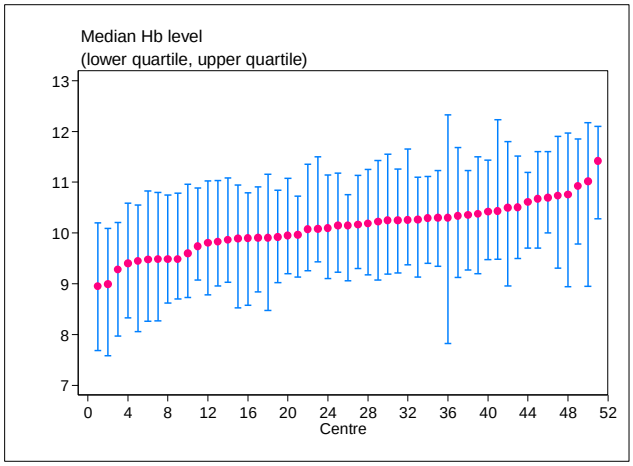


Figure 5.3.6(b): Variation in centres' proportion of patients on ESAs with haemoglobin level 10-11.5g/dL, PD centres, 2023

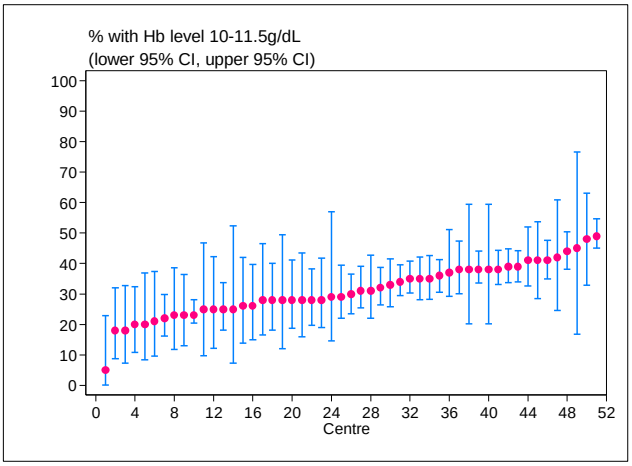


Table 5.3.6(b): Centres' proportion of patients on ESAs with haemoglobin level 10-11.5g/dL, PD centres, 2014-2023

Year	Number of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2023	51	5	18	25	30	38	45	49
2022	48	13	18	25	34.5	39	45	53
2021	47	17	21	26	33	42	50	52
2020	43	9	14	25	33	36	43	48
2019	36	16	18	27	33.5	41	46	48
2018	36	16	18	25.5	31	40	45	49
2017	36	17	19	25.5	33	39	47	51
2016	37	17	20	27	33	39	50	58
2015	35	13	17	26	33	42	50	57
2014	31	4	13	23	34	40	45	46

CHAPTER 6

BLOOD PRESSURE CONTROL AND DYSLIPIDAEMIA IN PATIENTS ON DIALYSIS

Yudisthra M. Ganeshadeva

SECTION 6.1: BLOOD PRESSURE CONTROL ON DIALYSIS

The control of pre dialysis systolic blood pressure (SBP) in haemodialysis (HD) patients has not improved over the last decade, with only 20% of HD patients achieving SBP < 140 mmHg (Table 6.1.1) in 2023. The mean and median pre dialysis SBP in HD patients in 2023 were at a relatively high figure of 154.2 mmHg and 154.5 respectively but finally shows a downward trend from 2022 where they were 154.6 and 155 respectively. Pre dialysis diastolic blood pressure (DBP) in HD patients was better controlled than pre dialysis SBP in 2023, with 85% of such patients achieving pre dialysis DBP < 90 mmHg (Table 6.1.2). The mean and median pre dialysis DBP in HD patients were satisfactory at 78.9 mmHg and 78.6 mmHg respectively in 2023. Over the past decade, the mean pre dialysis DBP in HD patients has remained the same since 2014.

The fact that SBP is less well controlled compared to DBP is not unexpected given that most patients on dialysis are in the older age group and that the prevalence of systolic hypertension rises with increasing age above 50 years. In addition, DBP may fall with increasing arterial stiffness seen in aging, hypertension, diabetes mellitus and chronic kidney disease, as well as in patients with left ventricular diastolic dysfunction.

Table 6.1.1: Distribution of pre dialysis systolic blood pressure, HD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <120 mmHg	% Patients 120-<140 mmHg	% Patients 140-<160 mmHg	% Patients 160-<180 mmHg	% Patients ≥180 mmHg
2023	52754	154.2	17.4	154.5	142.8	166.1	3	17	42	31	7
2022	50393	154.6	17.5	155	143.3	166.6	3	17	42	32	7
2021	49800	154	17.7	154.4	142.4	166	3	18	42	31	7
2020	47819	154.1	17.8	154.4	142.6	166.1	3	18	42	30	7
2019	44759	153.7	18.2	153.9	142	165.8	4	18	42	29	7
2018	41689	153.5	18.3	153.7	141.7	165.7	4	18	42	29	7
2017	40172	153.6	18.9	153.7	141.2	166	4	19	41	29	8
2016	36444	152.2	18.3	152.3	140.1	164.3	4	21	42	27	6
2015	33874	152.4	18.5	152.4	140.1	164.6	4	21	42	27	7
2014	31299	152.1	18.6	152	139.8	164.5	4	21	42	27	7

Figure 6.1.1: Cumulative distribution of pre dialysis systolic blood pressure, HD patients 2014-2023

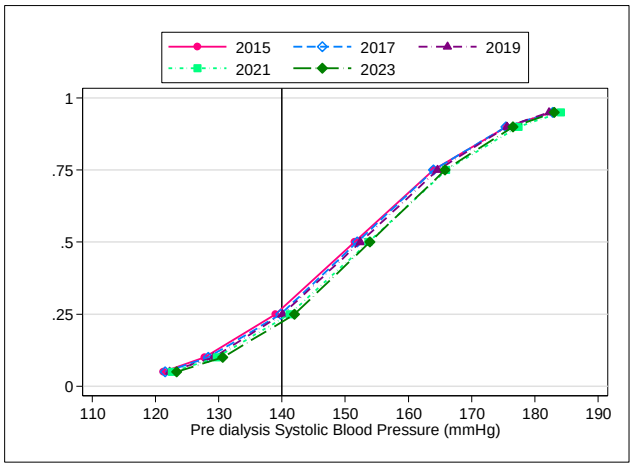


Figure 6.1.2: Cumulative distribution of pre dialysis diastolic blood pressure, HD patients 2014-2023

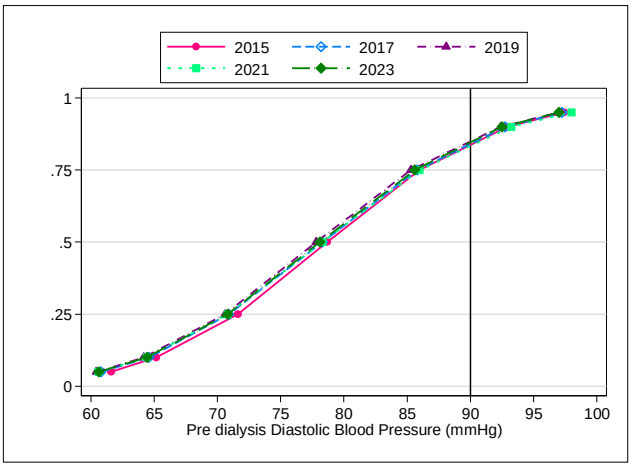


Table 6.1.2: Distribution of pre dialysis diastolic blood pressure, HD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <70 mmHg	% Patients 70-<80 mmHg	% Patients 80-<90 mmHg	% Patients 90-<100 mmHg	% Patients ≥100 mmHg
2023	52755	78.9	10.9	78.6	71.6	85.9	20	35	30	12	3
2022	50393	78.8	10.9	78.5	71.4	85.8	21	35	30	12	3
2021	49800	78.4	10.9	78.1	71.1	85.3	22	35	29	11	3
2020	47819	78.4	11	78.2	71	85.5	22	35	29	12	3
2019	44759	78.3	11.2	78.1	70.8	85.6	22	34	29	11	3
2018	41688	78.3	11.2	78	70.8	85.6	23	34	29	11	3
2017	40170	78.7	11.7	78.3	70.8	86	22	33	29	12	4
2016	36430	78.3	11.6	77.8	70.6	85.3	23	34	28	11	3
2015	33870	78.2	11.6	77.8	70.6	85.3	23	34	28	11	3
2014	31296	78.2	11.6	77.8	70.5	85.2	23	34	28	11	3

In contrast to HD patients, pre dialysis SBP in PD patients has been better controlled consistently over the last decade. In 2023, 37% of PD patients versus 20% of HD patients had a pre dialysis SBP < 140 mmHg (Table 6.1.3). The mean and median pre dialysis SBP in PD patients were lower than HD patients at 145.2 mmHg and 145.3 mmHg respectively. However, the mean pre dialysis SBP in PD patients over the past 10 years has increased from 143.9 mmHg in 2014 to 145.2 mmHg in 2023 as provision of PD has become less selective, as illustrated in Table 6.1.3. In 2023 pre dialysis DBP is well controlled in PD patients with 84% of these patients achieving pre dialysis DBP < 90 mmHg (Table 6.1.4), together with a mean DBP of 81.7 and median DBP of 81.9 mmHg.

Table 6.1.3: Distribution of pre dialysis systolic blood pressure, PD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <120 mmHg	% Patients 120-<140 mmHg	% Patients 140-<160 mmHg	% Patients 160-<180 mmHg	% Patients ≥180 mmHg
2023	7317	145.2	17.2	145.3	134.5	156.2	7	30	44	17	2
2022	7048	145.1	17.1	145.1	134	156	7	31	44	16	2
2021	6695	145.1	17.7	145.3	133.4	156.8	8	30	43	17	2
2020	6138	145.8	17.7	146.4	134.3	157.6	7	29	43	18	3
2019	5534	145.7	18.7	146.2	133.2	158.2	8	28	42	19	3
2018	5080	146.3	18.3	147	134.3	158.6	8	27	43	20	2
2017	4755	145.5	18.5	145.4	133.1	158.1	8	30	40	19	3
2016	4281	144.4	18.7	144.6	132	156.7	10	30	39	18	3
2015	3965	143.6	17.9	143.6	132	155.6	9	31	42	15	3
2014	3482	143.9	18.6	144.2	131.5	156.9	10	31	40	17	2

Figure 6.1.3: Cumulative distribution of pre dialysis systolic blood pressure, PD patients 2014-2023

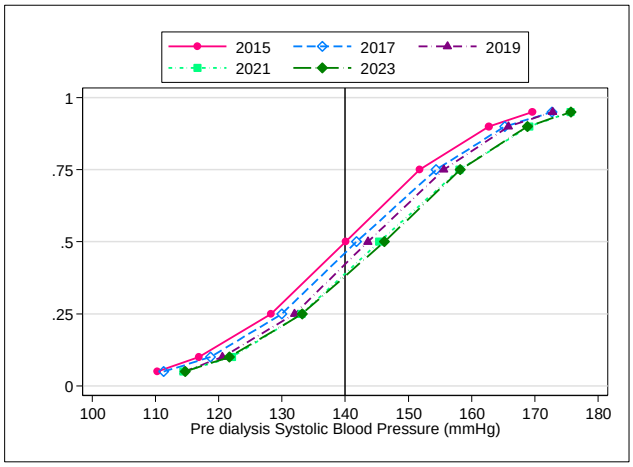


Figure 6.1.4: Cumulative Distribution of pre dialysis diastolic blood pressure, PD patients 2014-2023

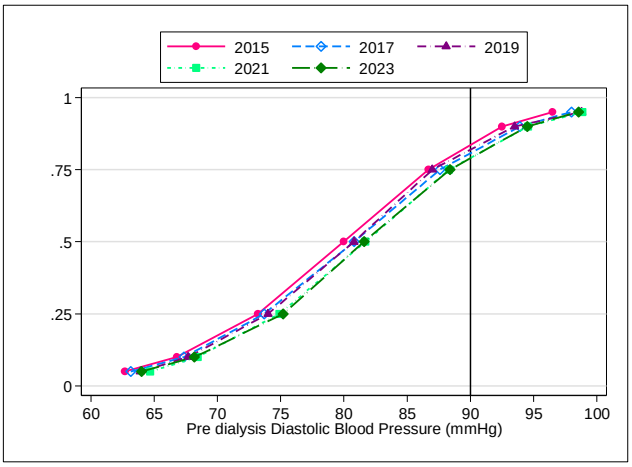


Table 6.1.4: Distribution of pre dialysis diastolic blood pressure, PD patients 2014-2023

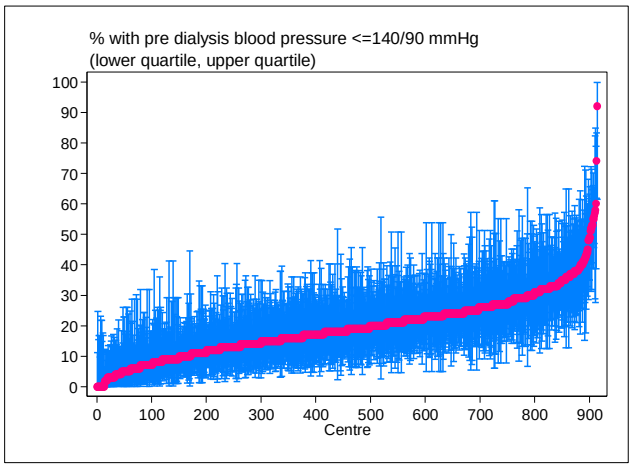
Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients <70 mmHg	% Patients 70-<80 mmHg	% Patients 80-<90 mmHg	% Patients 90-<100 mmHg	% Patients ≥100 mmHg
2023	7318	81.7	9.5	81.9	76.1	87.6	10	31	43	14	2
2022	7048	81.7	9.5	82.2	76.1	87.6	11	30	43	14	2
2021	6695	81.3	9.8	81.5	75.4	87.4	12	31	40	14	3
2020	6138	81.4	9.6	81.6	75.6	87.4	11	31	41	14	3
2019	5534	81.7	10.6	81.6	75.2	88.4	13	31	36	17	3
2018	5080	81.6	10.6	81.7	75.1	88.2	12	30	38	16	4
2017	4755	81.7	10.6	81.7	74.9	88.3	13	30	37	16	4
2016	4271	81.1	11.1	80.8	74.1	87.8	14	33	34	14	5
2015	3953	80.8	10.6	80.8	74	87	14	33	36	13	4
2014	3467	81	11.5	80.9	74	87.4	15	32	35	14	4

Overall, there is a wide inter-centre variation amongst haemodialysis centres in 2023 in terms of the proportion of patients achieving pre dialysis BP < 140/90 (Table & Figure 6.1.5a).

Table 6.1.5(a): Proportion of HD patients with pre dialysis blood pressure ≤140/90 mmHg, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	914	0	5	13	18.5	25	37	92
2022	857	0	4	12	18	25	38	91
2021	818	0	4	13	19	26	38	59
2020	782	0	6	13	19	26	40	81
2019	757	0	6	14	20	27	41	100
2018	736	0	6	14	20	28	41	92
2017	722	0	7	15	21	28	41	94
2016	695	0	8	16	23	30	45	92
2015	671	0	8	15	22	30	44	87
2014	644	0	7	17	23	32	46	93

Figure 6.1.5(a): Variation in proportion of HD patients with pre dialysis blood pressure ≤140/90 mmHg, HD centres 2023



There is significant inter-centre variation in both median SBP and DBP in HD patients in 2023 (Figures 6.1.5 b and c). In 2023, the difference between the HD centres with the 5th percentile and 95th percentile median BP was 21.2 mmHg for SBP (Table 6.1.5b) and 15.5 mmHg for DBP (Table 6.1.5c) respectively.

Table 6.1.5(b): Median systolic blood pressure among HD patients, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	914	117.9	144.4	150.8	154.7	159	165.6	177.7
2022	857	125.7	144.3	151.2	155.3	159.8	167.1	182.1
2021	818	133.4	144.2	150.3	154.3	158.8	165.5	178.7
2020	782	131.9	144.1	150.6	154.4	158.8	164.7	177.5
2019	757	122	144	149.9	154.3	158.3	164.9	178.5
2018	736	103.5	144.4	150	154.1	158.4	165.1	177.6
2017	722	109.1	143.9	149.9	153.8	158.3	165.6	185
2016	696	119.4	141.7	148.3	152.6	157	163.4	171.1
2015	671	120.4	141.7	148.6	152.9	157.5	164.6	174.5
2014	644	117.8	141.1	147.9	152.2	157.2	164.3	172.7

Figure 6.1.5(b): Variation in median systolic blood pressure among HD patients, HD centres 2023

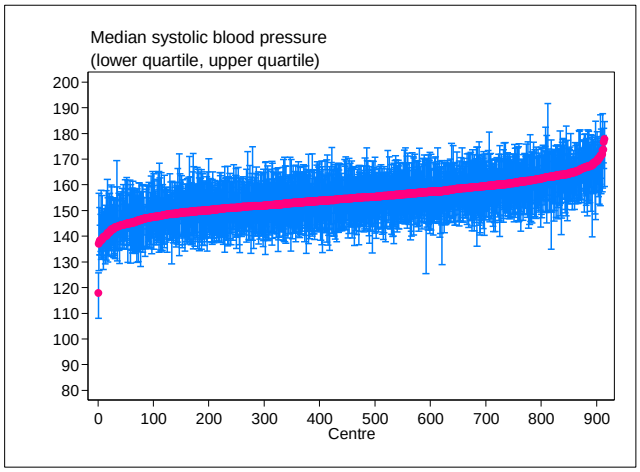


Figure 6.1.5(c): Variation in median diastolic blood pressure among HD patients, HD centres 2023

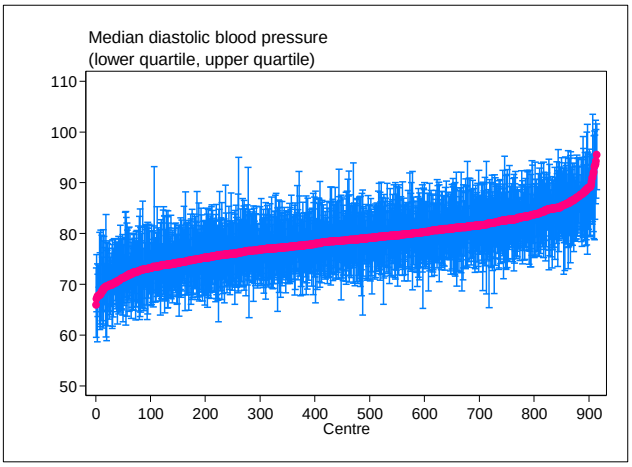


Table 6.1.5(c): Median diastolic blood pressure among HD patients, HD centres 2014-2023

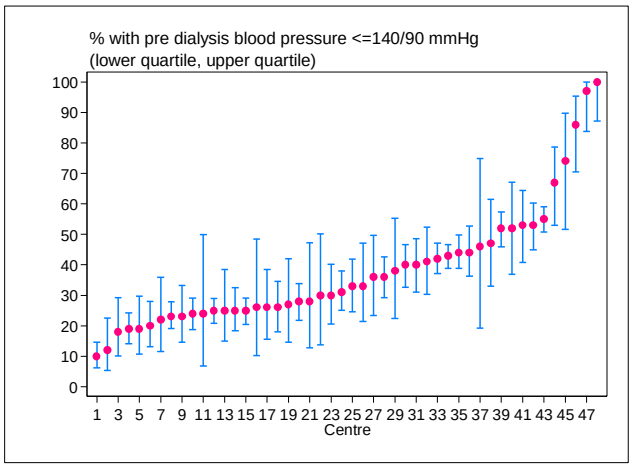
Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	914	65.9	71	75.8	78.7	81.5	86.5	95.5
2022	857	64.4	71.2	75.7	79	81.9	86.1	97.9
2021	818	64.4	70.5	75.3	78.4	81.4	86.1	97.3
2020	782	62.7	70.5	75.3	78.4	81.3	85.8	94.8
2019	757	61.9	70.8	75.2	78.4	81.1	85.5	93.5
2018	736	62.8	70.4	75.2	78.3	81	85.5	101.1
2017	722	65	70.9	75.3	78.4	81.4	86.6	132
2016	695	63.8	71	75	77.9	81.1	85.5	127.1
2015	671	64.9	70.6	75	78	81	85.6	94.2
2014	644	64.7	70.5	74.8	77.8	81	85.4	120.6

Similar to haemodialysis centres, there was also a wide variation amongst PD centres in the proportion of patients achieving BP < 140/90 in 2022 (Table & Figure 6.1.6a).

Table 6.1.6(a): Proportion of PD patients with pre dialysis blood pressure ≤140/90 mmHg, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	48	10	18	25	32	45	86	100
2022	47	3	16	26	35	43	100	100
2021	46	3	21	28	33	45	89	97
2020	43	14	22	25	36	50	94	100
2019	39	7	19	24	37	42	94	96
2018	38	6	14	25	33	39	92	100
2017	36	10	11	28	36.5	45.5	91	100
2016	37	19	19	32	40	48	100	100
2015	35	24	28	33	40	47	98	100
2014	31	9	20	30	37	50	97	100

Figure 6.1.6(a): Variation in proportion of PD patients with pre dialysis blood pressure ≤140/90 mmHg, PD centres 2023



The difference between the PD centres with the 5th percentile and 95th percentile median BP was 42.9 mmHg for SBP in 2023 (Table 6.1.6b). There was also significant inter-centre variation in median DBP in PD patients in 2023 of 12.9mmHg (Table & Figure 6.1.6c).

Table 6.1.6(b): Median systolic blood pressure among PD patients, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	48	106.5	114.7	140.5	144.8	150.1	157.6	159.9
2022	47	107.3	113.3	141	145.5	150.3	154	158.6
2021	46	108.3	114.6	141.2	146.5	149.1	155.2	157.1
2020	43	109.3	114.7	139.4	146.3	150.4	153.5	157.6
2019	39	115.5	116.5	140.7	145.9	150.6	157	161
2018	38	112.7	116.5	143.3	146.1	150	155.2	158
2017	36	117.3	118.6	140.3	144.9	149.2	158.1	160
2016	37	111.9	116.6	139	143.3	148	152.3	161
2015	35	114.6	115	138.4	142.6	145.5	150.5	153.3
2014	31	114.8	115.2	138.4	145	147.3	154.2	158.4

Figure 6.1.6(b): Variation in median systolic blood pressure among PD patients, PD centres 2023

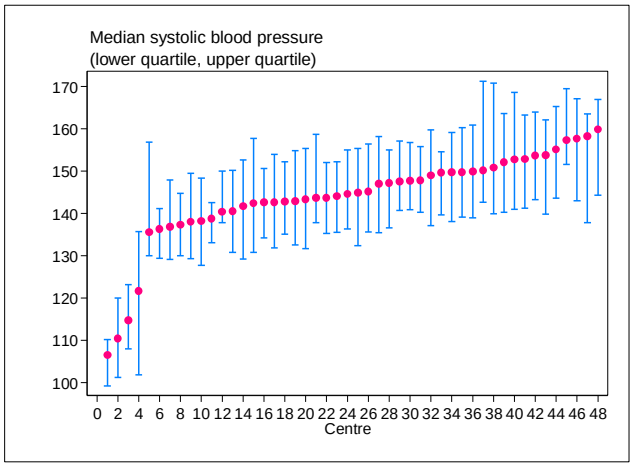


Figure 6.1.6(c): Variation in median diastolic blood pressure among PD patients, PD centres 2023

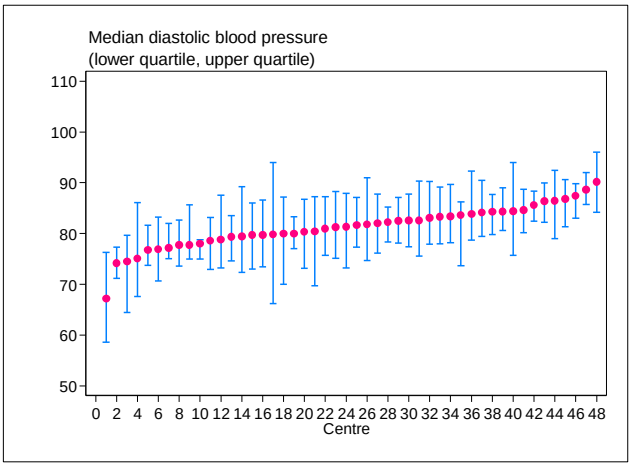


Table 6.1.6(c): Median diastolic blood pressure among PD patients, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	48	67.2	74.5	79.1	81.5	83.9	87.4	90.2
2022	47	68.9	70.1	80	81.8	84	86.6	91
2021	46	67	75.1	78.2	81.6	83.5	87.9	90
2020	43	68.3	74.7	79.8	81.3	84	85.8	86.2
2019	39	70	74.5	78.9	81.9	83.8	87.1	87.3
2018	38	65.9	71.6	79.2	82.8	83.9	87.2	87.5
2017	36	72.5	74.3	80	81.5	84.6	87.7	88
2016	37	72.8	73.7	79.5	81.1	83	86.9	87.5
2015	35	70.5	73.1	78.7	81.9	84.1	89.5	94.1
2014	31	73.8	75	79.4	81	83.9	89.9	92.3

SECTION 6.2: DYSLIPIDAEMIA IN DIALYSIS PATIENTS

Individuals with end stage kidney disease (ESKD) are at high risk for cardiovascular (CV) morbidity and mortality. Cardiovascular disease (CVD) is the most common cause of death in dialysis patients. Hence, they should be screened for the traditional CV risk factors and treated appropriately. However, patients on dialysis have not had similar benefits of lipid lowering therapy as compared to patients with earlier stages of CKD and the general population

In 2023, 67% of HD patients achieved the moderate CV risk target of an LDL cholesterol < 2.6 mmol/L. This was 59% 10 years ago in 2014 (Table 6.2.1). The percentage of patients achieving a high CV risk target of LDL cholesterol <1.8mmol/L in 2023 was 30% compared to only 21% in 2014. Median LDL Cholesterol levels also improved from 2.4mmol/L in 2014 to 2.2mmol/L in 2023. This improvement with more widespread use and availability of moderate to high intensity statins.

Table 6.2.1: Distribution of LDL cholesterol, HD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <1.8 mmol/L	% patients 1.8-<2.6 mmol/L	% patients ≥2.6 mmol/L
2023	50079	2.3	0.9	2.2	1.7	2.8	30	37	33
2022	47685	2.4	0.9	2.3	1.7	2.9	29	37	34
2021	46912	2.4	0.9	2.3	1.7	2.9	29	36	35
2020	45280	2.4	0.9	2.3	1.8	2.9	27	37	36
2019	41486	2.4	0.9	2.3	1.8	2.9	26	37	37
2018	38359	2.4	0.9	2.3	1.8	2.9	26	37	37
2017	36685	2.5	0.9	2.3	1.8	3	24	37	39
2016	32756	2.5	0.9	2.4	1.9	3	23	38	39
2015	30478	2.5	0.9	2.4	1.9	3	23	38	39
2014	27756	2.5	0.9	2.4	1.9	3	21	38	41

61% of PD patients achieved the moderate CV risk target of a LDL Cholesterol of <2.6mmol/L in 2023 compared to 46% a decade earlier in 2014. The percentage of patients achieving a high CV risk target of LDL Cholesterol <1.8mmol/L was 21% compared to only 15% in 2014. Again, this improvement could be due to the same medication factors as for HD patients.

Table 6.2.2: Distribution of LDL cholesterol, PD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <1.8 mmol/L	% patients 1.8-<2.6 mmol/L	% patients ≥2.6 mmol/L
2023	6816	2.7	1.1	2.6	1.9	3.4	21	30	49
2022	6376	2.8	1.1	2.6	2	3.4	19	31	50
2021	6246	2.7	1.2	2.6	1.9	3.4	21	30	49
2020	5834	2.8	1.2	2.6	2	3.5	20	30	50
2019	5215	2.8	1.2	2.6	2	3.4	20	30	50
2018	4940	2.8	1.1	2.6	2	3.4	19	31	51
2017	4313	2.8	1.1	2.6	2	3.4	19	31	50
2016	4151	2.8	1.1	2.7	2	3.4	17	30	53
2015	3890	2.8	1.1	2.7	2.1	3.4	16	31	53
2014	3348	2.9	1.1	2.7	2.1	3.5	15	31	54

With regards to triglyceride levels, 85% of HD patients had triglyceride levels of <2.3 mmol/L in 2023 (Table 6.2.3). The mean and median serum triglyceride in HD patients in 2023 were 1.6 mmol/L and 1.3 mmol/L, showing an improvement from 1.8 and 1.5 mmol/L respectively a decade ago.

Table 6.2.3: Distribution of serum triglyceride, HD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <1.7 mmol/L	% patients 1.7-<2.3 mmol/L	% patients 2.3-<3.5 mmol/L	% patients ≥3.5 mmol/L
2023	50340	1.6	0.9	1.3	1	1.9	68	17	11	4
2022	47918	1.6	0.9	1.4	1	1.9	67	18	11	4
2021	47132	1.6	1	1.4	1	2	65	18	12	5
2020	45726	1.6	1	1.4	1	2	65	18	12	5
2019	42275	1.7	1	1.4	1	2	63	19	13	5
2018	39593	1.7	1	1.5	1.1	2.1	61	19	14	6
2017	37797	1.8	1.1	1.5	1.1	2.2	59	19	15	7
2016	33782	1.8	1.1	1.5	1.1	2.2	57	20	15	8
2015	31292	1.8	1.1	1.5	1.1	2.2	58	20	15	7
2014	28802	1.8	1.1	1.5	1.1	2.2	58	19	15	8

Figure 6.2.3: Cumulative distribution of serum triglyceride, HD patients 2014-2023

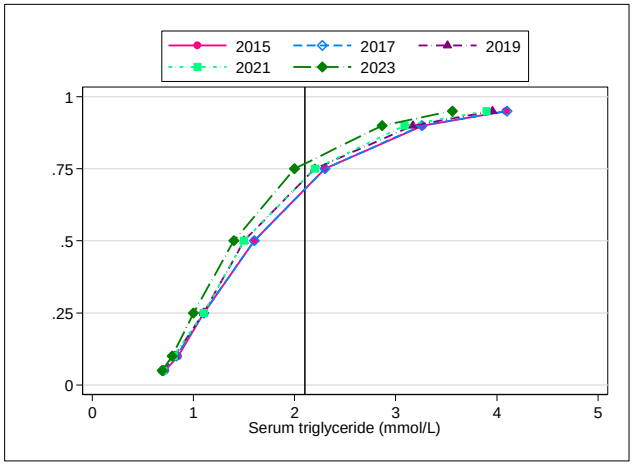
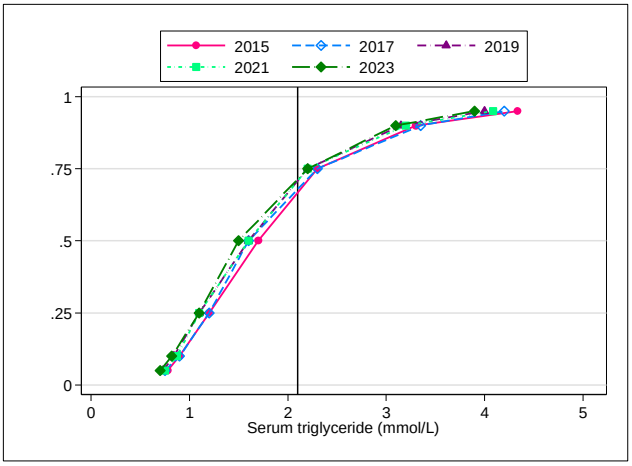


Figure 6.2.4: Cumulative distribution of serum triglyceride, PD patients 2014-2023



80% of Peritoneal dialysis patients had a triglyceride level of < 2.3 mmol/L in 2023 (Table 6.2.4). The mean and median serum triglyceride levels in PD patients have decreased over the past 10 years from 1.9 mmol/L and 1.6 mmol/L in 2014 to 1.8 mmol/L and 1.5 mmol/L in 2023 respectively.

Table 6.2.4: Distribution of serum triglyceride, PD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients <1.7 mmol/L	% patients 1.7-<2.3 mmol/L	% patients 2.3-<3.5 mmol/L	% patients ≥3.5 mmol/L
2023	6968	1.8	1.1	1.5	1.1	2.1	61	19	14	6
2022	6573	1.8	1.1	1.5	1.1	2.2	59	20	15	6
2021	6384	1.8	1.1	1.5	1.1	2.2	59	20	15	6
2020	5907	1.8	1.1	1.5	1.1	2.2	58	20	15	7
2019	5373	1.8	1.1	1.5	1.1	2.2	58	20	14	8
2018	5026	1.8	1.1	1.5	1.1	2.2	58	20	15	7
2017	4344	1.9	1.2	1.6	1.1	2.2	55	22	15	8
2016	4192	1.9	1.2	1.6	1.2	2.3	52	22	17	9
2015	3925	1.9	1.1	1.6	1.1	2.2	55	21	16	8
2014	3352	1.9	1.1	1.6	1.1	2.3	55	21	15	9

Overall, the median LDL Cholesterol levels has dropped from 2.5 in 2014 to 2.3 in 2023 (Table 6.2.5a). There was slight inter-centre variation in median LDL cholesterol levels and the proportion of HD patients with LDL cholesterol < 2.6mmol/L varied by 15% between the LQ and UQ in HD centres in 2023 although this variation has been stable over the past decade (Table 6.2.5b)

Table 6.2.5(a): Median LDL cholesterol level among HD patients, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	887	1.4	1.8	2.1	2.3	2.4	2.7	3.8
2022	826	1.5	1.9	2.1	2.3	2.5	2.7	3.8
2021	791	1.3	1.8	2.1	2.3	2.4	2.7	3.6
2020	758	1.6	1.9	2.1	2.3	2.5	2.8	3.9
2019	729	1.4	1.9	2.1	2.3	2.5	2.8	3.8
2018	704	1.6	1.9	2.1	2.3	2.5	2.8	4
2017	683	1.7	2	2.2	2.4	2.5	2.9	4.5
2016	660	1.4	2	2.2	2.4	2.6	2.8	4.1
2015	643	1.1	2	2.3	2.4	2.6	2.9	4.2
2014	599	1.6	2	2.3	2.5	2.6	2.9	3.7

Figure 6.2.5(a): Variation in median LDL cholesterol level among HD patients, HD centres 2023

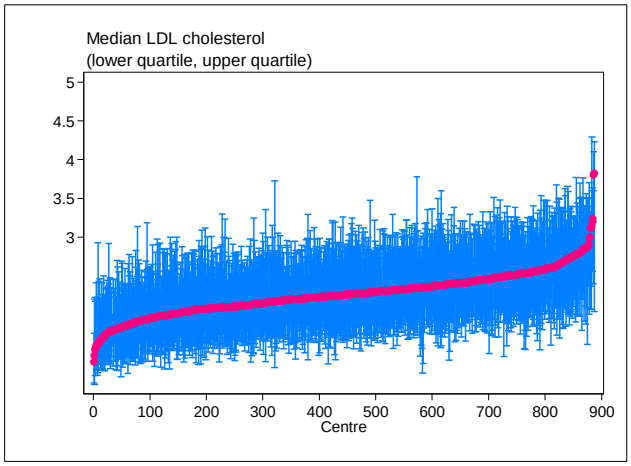


Figure 6.2.5(b): Variation in proportion of patients with LDL cholesterol <2.6 mmol/L, HD centres 2023

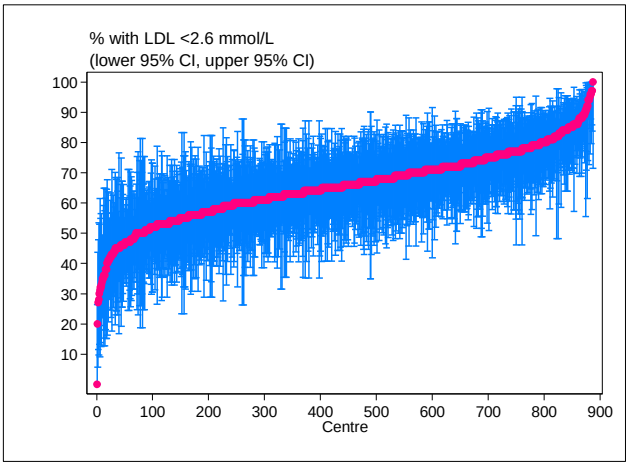


Table 6.2.5(b): Proportion of HD patients with LDL cholesterol <2.6 mmol/L, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	887	0	46	58	66	73	85	100
2022	826	13	44	57	65	73	83	97
2021	791	15	44	57	65	73	82	95
2020	758	0	41	56	63	71	82	100
2019	729	10	40	56	64	71	82	95
2018	704	4	40	53	64	72	82	100
2017	683	0	40	53	62	69	79	94
2016	660	5	40	51	60	68.5	78.5	100
2015	643	0	39	52	59	68	79	92
2014	599	14	37	50	58	67	79	92

For median serum triglyceride levels amongst HD centres, the difference between the 5th percentile and 95th percentile was only 0.5 mmol/L (Table & Figure 6.2.5c). There is a 10% difference between the LQ and UQ in terms of the proportion of patients with serum triglyceride < 2.1 mmol/L in HD centres in 2023. This is relatively unchanged from a decade ago (Table & Figure 6.2.5d).

Table 6.2.5(c): Median serum triglyceride level among HD patients, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	900	0.9	1.1	1.2	1.3	1.5	1.6	2.5
2022	839	0.8	1.1	1.2	1.4	1.5	1.7	2.3
2021	798	0.9	1.1	1.3	1.4	1.5	1.8	2.1
2020	768	0.9	1.1	1.3	1.4	1.5	1.7	2.5
2019	735	0.9	1.1	1.3	1.4	1.6	1.8	3.5
2018	720	0.9	1.1	1.3	1.5	1.6	1.8	2.5
2017	698	0.9	1.2	1.4	1.5	1.7	2	2.9
2016	674	0.9	1.2	1.4	1.5	1.7	2	2.7
2015	652	1	1.2	1.4	1.5	1.7	1.9	2.5
2014	619	1	1.2	1.4	1.5	1.7	2	2.5

Figure 6.2.5(c): Variation in median serum triglyceride level among HD patients, HD centres 2023

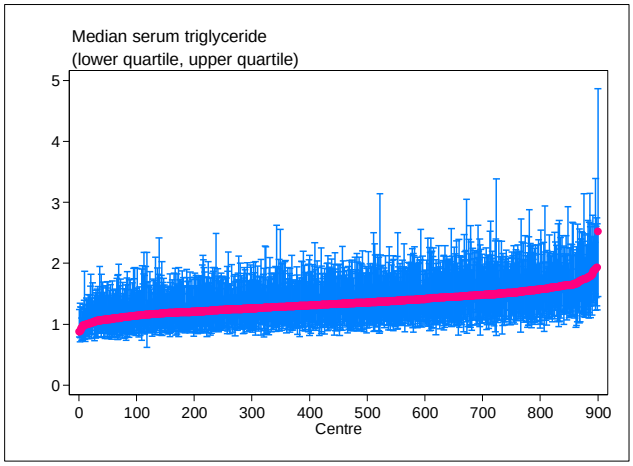


Figure 6.2.5(d): Variation in proportion of patients with serum triglyceride <2.1 mmol/L, HD centres 2023

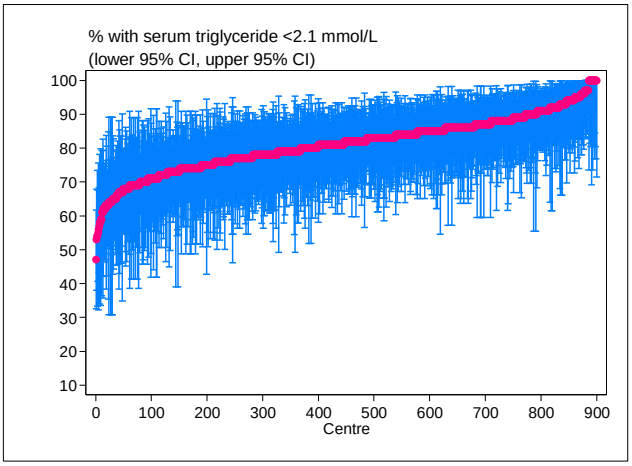


Table 6.2.5(d): Proportion of HD patients with serum triglyceride <2.1 mmol/L, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	900	47	67	76	82	86	94	100
2022	839	40	67	76	81	86	93	100
2021	798	50	63	73	79	85	93	100
2020	768	33	64	74	79	85	92	100
2019	735	26	62	71	78	84	91	100
2018	720	42	60.5	70	76	82	90	100
2017	698	0	55	67	74	80	89	100
2016	674	36	54	65	72	79	88	100
2015	652	39	56	66	72	80	89	100
2014	619	36	53	65	73	80	89	100

There was some inter-centre variation in median LDL cholesterol levels among PD patients in 2023 with the difference between the 5th percentile and 95th percentile being 0.9 mmol/L (Table & Figure 6.2.6a). There is a 16% difference between the LQ and UQ of the proportion of patients with serum LDL cholesterol < 2.6mmol/L (Figure 6.2.6b). This was 13% a decade ago and therefore relatively unchanged.

Table 6.2.6(a): Median serum LDL level among PD patients, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	887	1.4	1.8	2.1	2.3	2.4	2.7	3.8
2022	826	1.5	1.9	2.1	2.3	2.5	2.7	3.8
2021	791	1.3	1.8	2.1	2.3	2.4	2.7	3.6
2020	758	1.6	1.9	2.1	2.3	2.5	2.8	3.9
2019	729	1.4	1.9	2.1	2.3	2.5	2.8	3.8
2018	704	1.6	1.9	2.1	2.3	2.5	2.8	4
2017	683	1.7	2	2.2	2.4	2.5	2.9	4.5
2016	660	1.4	2	2.2	2.4	2.6	2.8	4.1
2015	643	1.1	2	2.3	2.4	2.6	2.9	4.2
2014	599	1.6	2	2.3	2.5	2.6	2.9	3.7

Figure 6.2.6(a): Variation in median LDL cholesterol level among PD patients, PD centres 2023

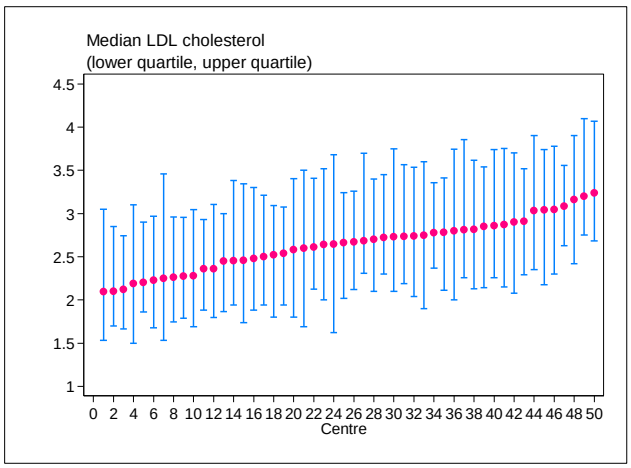


Figure 6.2.6(b): Variation in proportion of patients with LDL cholesterol <2.6 mmol/L, PD centres 2023

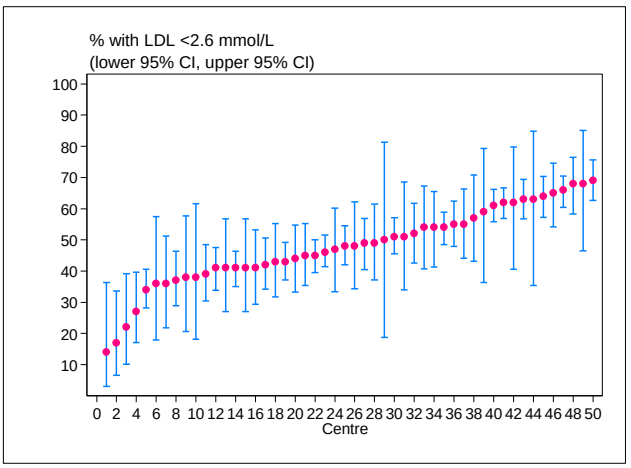


Table 6.2.6(b): Proportion of PD patients with LDL cholesterol <2.6 mmol/L, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	50	14	22	41	48	57	68	69
2022	48	18	20	34.5	48.5	53.5	65	67
2021	44	10	19	36	48.5	54.5	61	69
2020	42	11	13	31	48.5	56	62	71
2019	39	4	11	33	46	56	65	66
2018	36	9	16	30	48.5	57.5	70	71
2017	35	13	16	30	49	57	63	65
2016	34	18	21	36	42.5	54	67	67
2015	33	9	14	31	42	55	62	66
2014	29	14	20	30	39	53	60	62

As in previous years, there was only a small inter-centre variation in median triglyceride levels among PD centres (Figure 6.2.6c). There was some inter-centre variation amongst PD centres in the proportion of patients with serum triglyceride levels < 2.1 mmol/L. (Table & Figure 6.2.6d).

Table 6.2.6(c): Median serum triglyceride level among PD patients, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	50	1.3	1.3	1.4	1.5	1.6	1.9	2
2022	49	1.2	1.3	1.4	1.5	1.6	2	2.3
2021	46	1.3	1.4	1.4	1.5	1.6	1.9	2
2020	42	1.2	1.3	1.4	1.5	1.6	1.9	2.1
2019	39	1.2	1.2	1.4	1.5	1.7	2	2.1
2018	38	1.2	1.3	1.4	1.5	1.6	2	2.2
2017	36	1.3	1.4	1.5	1.6	1.7	2	2.1
2016	36	1.3	1.3	1.5	1.7	1.8	2	2.1
2015	34	1.4	1.4	1.5	1.6	1.6	1.8	2.6
2014	30	1.2	1.3	1.5	1.6	1.6	1.9	2.3

Figure 6.2.6(c): Variation in median serum triglyceride level among PD patients, PD centres 2023

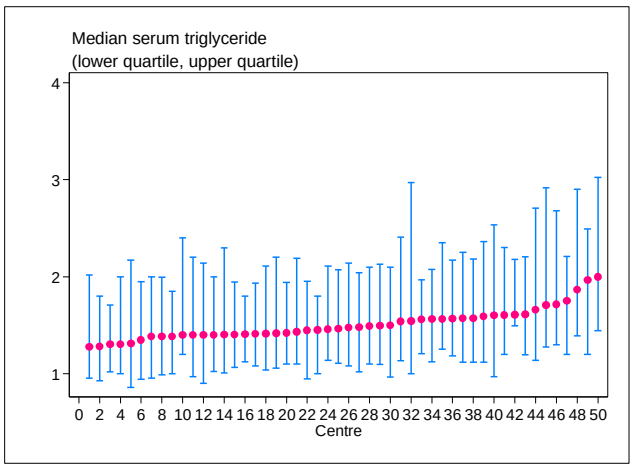


Figure 6.2.6(d): Variation in proportion of patients with serum triglyceride <2.1 mmol/L, PD centres 2023

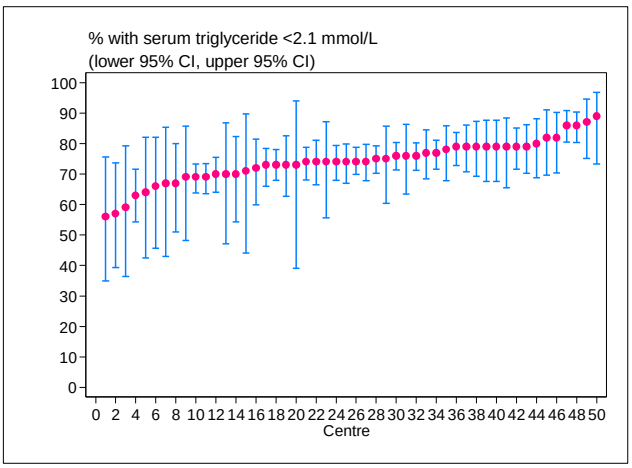


Table 6.2.6(d): Proportion of PD patients with serum triglyceride <2.1 mmol/L, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	50	56	59	70	74	79	86	89
2022	49	47	50	69	74	78	83	85
2021	46	52	60	70	74.5	78	83	85
2020	42	52	58	68	73	77	81	100
2019	39	52	55	67	73	76	87	90
2018	38	47	56	68	71.5	77	83	85
2017	36	55	55	67	70	75.5	84	87
2016	36	53	61	65	69.5	75	88	90
2015	34	36	55	68	72.5	77	88	90
2014	30	43	58	64	72	76	79	81

CHAPTER 7

CHRONIC KIDNEY DISEASE - MINERAL AND BONE DISORDER IN DIALYSIS PATIENTS

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SECTION 7.1: TREATMENT OF HYPERPHOSPHATAEMIA

Calcium carbonate remained as the main phosphate binder for both HD patients (94 - 97%) and PD patients (90-95%) from 2014-2023. Sevelamer has been the second most used phosphate binder. Its use has been increasing in trend for the past years for both HD and PD patients. The usage for lanthanum has been decreasing steadily over the same period which accounted for 0 -1 % of HD and PD patients in 2023. The use of other phosphate binders (e.g., calcium acetate and sucroferric oxyhydroxide) has been gradually increasingly although the number was still very small for both HD and PD patients (Tables 7.1.1 and 7.1.2).

Table 7.1.1: Phosphate Binder in HD patients, 2014-2023

Year	Number of patients	Number of patients on Calcium based binders		Number of patients on Lanthanum		Number of patients on Sevelamer		Number of Patients on Other Non-calcium based binders	
		n	%	n	%	n	%	n	%
2023	52031	48937	94	280	0	2371	5	443	1
2022	49443	46985	95	305	1	1957	4	196	0
2021	48583	46490	96	324	1	1628	3	141	0
2020	46747	44668	96	337	1	1597	3	145	0
2019	43059	40754	95	683	2	1460	3	162	0
2018	40044	38005	95	674	2	1194	3	171	0
2017	39259	37485	95	694	2	929	2	151	1
2016	35278	34109	97	613	2	506	1	50	0
2015	32842	31604	96	804	2	359	1	75	1
2014	30071	29059	97	783	3	210	0	19	0

Table 7.1.2: Phosphate Binder in PD patients, 2014-2023

Year	Number of patients	Number of patients on Calcium based binders		Number of patients on Lanthanum		Number of patients on Sevelamer		Number of Patients on Other Non-calcium based binders	
		n	%	n	%	n	%	n	%
2023	7578	6805	90	82	1	669	9	22	0
2022	7098	6450	91	66	1	572	8	10	0
2021	6702	6154	92	63	1	479	7	6	0
2020	5838	5350	92	58	1	418	7	12	0
2019	5499	5055	92	69	1	373	7	2	0
2018	5071	4674	93	74	1	320	6	3	0
2017	4677	4307	92	92	2	274	6	4	0
2016	4117	3850	94	96	2	170	4	1	0
2015	3799	3584	95	122	3	93	2	0	0
2014	3299	3137	95	119	4	40	1	3	0

Since 2014, lanthanum and sevelamer have been primarily used in the private sector. Over time, the public and NGO sectors have increased their usage (Table 7.1.3).

Table 7.1.3: Phosphate Binders by Sector in HD patients

Year	Sector	Calcium based binders		Lanthanum		Sevelamer		Other Non-calcium based binders	
		n	%	n	%	n	%	n	%
2023	Public	9230	19	68	24	813	35	16	4
	Private	30251	62	138	49	1230	53	357	81
	NGO	8929	18	74	26	281	12	66	15
	Total	**48410**	**100**	**280**	**100**	**2324**	**100**	**439**	**100**
2022	Public	9428	20	75	25	621	32	17	9
	Private	28092	60	159	52	1084	56	140	72
	NGO	8916	19	71	23	227	12	37	19
	Total	**46436**	**100**	**305**	**100**	**1932**	**100**	**194**	**100**
2021	Public	9500	21	93	29	501	31	26	19
	Private	27237	59	162	50	902	56	83	60
	NGO	9210	20	68	21	203	13	29	21
	Total	**45947**	**100**	**323**	**100**	**1606**	**100**	**138**	**100**
2020	Public	9578	22	114	34	453	29	33	23
	Private	25371	57	161	48	894	57	85	59
	NGO	9248	21	60	18	229	15	25	17
	Total	**44197**	**100**	**335**	**100**	**1576**	**100**	**143**	**100**
2019	Public	9285	23	173	26	424	29	17	10
	Private	22422	56	304	45	805	55	111	69
	NGO	8667	21	197	29	224	15	34	21
	Total	**40374**	**100**	**674**	**100**	**1453**	**100**	**162**	**100**
2018	Public	8968	24	177	27	343	29	19	11
	Private	20278	54	291	44	647	54	104	61
	NGO	8446	22	197	30	200	17	48	28
	Total	**37692**	**100**	**665**	**100**	**1190**	**100**	**171**	**100**
2017	Public	8852	24	186	27	263	28	14	9
	Private	19951	54	303	44	524	57	81	54
	NGO	8417	23	197	29	140	15	56	37
	Total	**37220**	**100**	**686**	**100**	**927**	**100**	**151**	**100**
2016	Public	8084	24	199	33	121	24	10	20
	Private	17890	53	247	41	324	64	31	62
	NGO	7944	23	161	27	60	12	9	18
	Total	**33918**	**100**	**607**	**100**	**505**	**100**	**50**	**100**
2015	Public	7459	24	245	31	74	21	6	8
	Private	16452	52	347	43	244	68	48	65
	NGO	7567	24	209	26	41	11	20	27
	Total	**31478**	**100**	**801**	**100**	**359**	**100**	**74**	**100**
2014	Public	6997	24	233	30	42	20	1	5
	Private	14544	50	324	42	146	70	14	74
	NGO	9230	19	68	24	813	35	16	4
	Total	**30251**	**62**	**138**	**49**	**1230**	**53**	**357**	**81**

SECTION 7.2: SERUM CALCIUM AND PHOSPHATE CONTROL

The median corrected serum calcium level had remained constant since 2014 for both HD and PD patients (2.2 mmol/L). 50 % of HD patients achieved the target serum calcium level of 2.1 to 2.37 mmol/L compared to 47 % of PD patients in 2023 (Tables & Figures 7.2.1 and 7.2.2).

Table 7.2.1: Distribution of corrected serum calcium, HD patients 2014-2023

Year	Number of Patient	Mean	SD	Median	LQ	UQ	% patients ≥2.1 & ≤2.37 mmol/L
2023	51666	2.2	0.2	2.2	2.1	2.3	50
2022	49199	2.2	0.2	2.2	2.1	2.3	50
2021	48988	2.2	0.2	2.2	2.1	2.3	48
2020	47217	2.2	0.2	2.2	2.1	2.4	49
2019	44390	2.2	0.2	2.2	2.1	2.4	49
2018	41493	2.2	0.2	2.2	2.1	2.4	49
2017	39968	2.2	0.2	2.2	2.1	2.3	49
2016	36299	2.2	0.2	2.2	2.1	2.3	50
2015	33786	2.2	0.2	2.2	2.1	2.3	50
2014	31150	2.2	0.2	2.2	2.1	2.4	50

Figure 7.2.1: Cumulative distribution of corrected serum calcium, HD patients 2014-2023

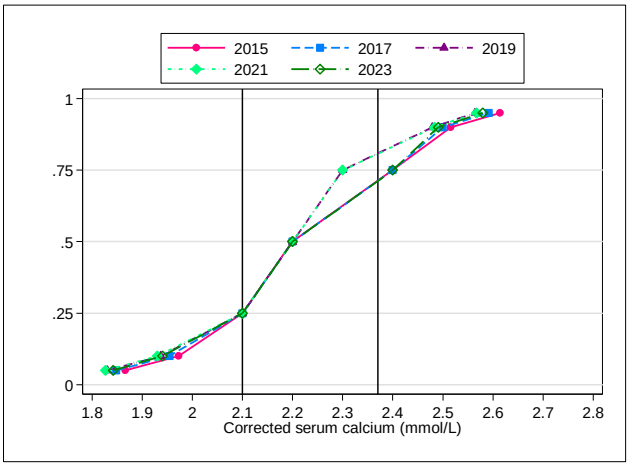


Figure 7.2.2: Cumulative distribution of corrected serum calcium, PD patients 2014-2023

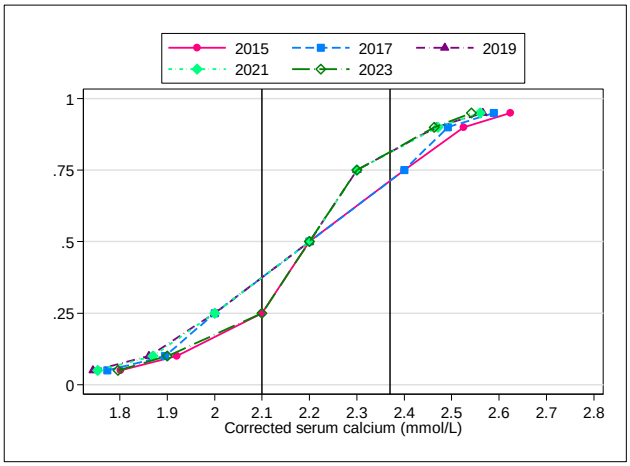


Table 7.2.2: Distribution of corrected serum calcium, PD patients 2014-2023

Year	Number of Patient	Mean	SD	Median	LQ	UQ	% patients ≥2.1 & ≤2.37 mmol/L
2023	7741	2.2	0.2	2.2	2	2.3	47
2022	7257	2.2	0.2	2.2	2	2.3	48
2021	6823	2.2	0.2	2.2	2	2.3	45
2020	6198	2.2	0.2	2.2	2	2.3	47
2019	5827	2.2	0.2	2.2	2.1	2.3	48
2018	5355	2.2	0.2	2.2	2	2.3	46
2017	4988	2.2	0.2	2.2	2	2.3	44
2016	4545	2.2	0.2	2.2	2	2.3	45
2015	4215	2.2	0.2	2.2	2	2.3	43
2014	3629	2.2	0.2	2.2	2	2.3	45

Overall, PD patients had better phosphate control compared to HD patients (median level 1.6 vs 1.7mmol/L). Majority of the patients achieved a phosphate level between 1.3 – 1.8mmol/L (HD patients 38% and PD patients 40%). 21% of PD patients achieved a phosphate level of 0.8-1.3mmol/L whereas only 16% of HD patients achieved this target (Tables & Figures 7.2.3 and 7.2.4). It is important to note that the KDIGO 2017 guidelines on CKD-MBD do not define a specific target range for serum phosphate. Instead, they recommend maintaining phosphate levels as close to the normal range as possible.

Table 7.2.3: Distribution of serum phosphate, HD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	%patients <0.8 mmol/L	%patients ≥0.8&<1.3 mmol/L	%patients ≥1.3&<1.8 mmol/L	%patients ≥1.8&<2.2 mmol/L	%patients ≥2.2 mmol/L
2023	52210	1.8	0.5	1.7	1.4	2.1	1	16	38	25	20
2022	49724	1.8	0.5	1.8	1.4	2.1	1	15	37	26	21
2021	49147	1.8	0.5	1.8	1.5	2.1	1	14	37	27	21
2020	47400	1.8	0.5	1.8	1.5	2.1	1	14	38	27	20
2019	44219	1.8	0.5	1.7	1.4	2.1	1	16	38	27	18
2018	41338	1.8	0.5	1.7	1.4	2.1	1	16	38	26	18
2017	39961	1.8	0.5	1.7	1.4	2	1	16	40	26	17
2016	36195	1.8	0.5	1.7	1.4	2	1	17	39	27	17
2015	33678	1.7	0.5	1.7	1.4	2	1	18	39	25	17
2014	31047	1.7	0.5	1.7	1.4	2	2	18	39	24	17

Figure 7.2.3: Cumulative distribution of serum phosphate, HD patients 2014-2023

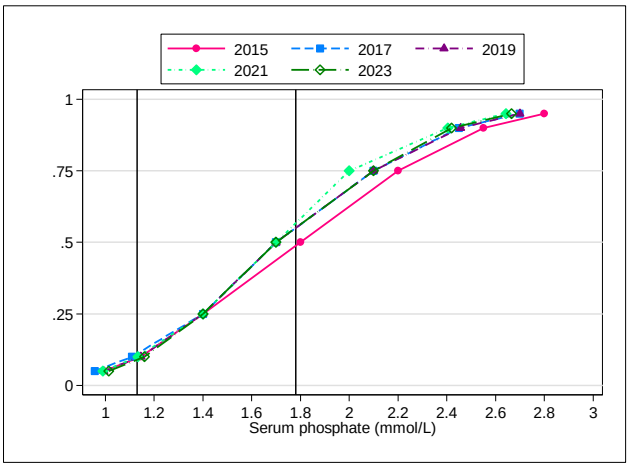


Figure 7.2.4: Cumulative distribution of serum phosphate, PD patients 2014-2023

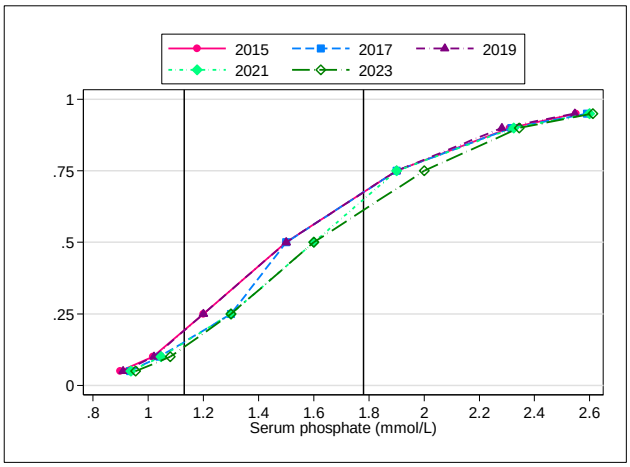


Table 7.2.4: Distribution of serum phosphate, PD patients 2014-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	%patients <0.8 mmol/L	%patients ≥0.8&<1.3 mmol/L	%patients ≥1.3&<1.8 mmol/L	%patients ≥1.8&<2.2 mmol/L	%patients ≥2.2 mmol/L
2023	7810	1.7	0.5	1.6	1.3	2	1	21	40	21	17
2022	7342	1.7	0.5	1.6	1.3	2	1	21	40	21	16
2021	7031	1.7	0.5	1.7	1.4	2	1	20	39	23	17
2020	6372	1.7	0.5	1.6	1.3	2	2	22	39	22	16
2019	5801	1.7	0.5	1.6	1.3	2	2	23	40	20	15
2018	5348	1.7	0.5	1.6	1.3	2	2	23	39	21	15
2017	4981	1.7	0.5	1.6	1.3	2	2	24	40	20	14
2016	4537	1.6	0.5	1.6	1.3	1.9	2	25	40	19	13
2015	4204	1.6	0.5	1.6	1.3	1.9	2	26	41	18	13
2014	3621	1.6	0.5	1.6	1.3	1.9	2	26	40	18	14

The variation in corrected serum calcium level among both HD and PD centres remained wide. (Table and Figure 7.2.5(a) & 7.2.6(a)

Table 7.2.5(a): Variation in corrected median serum calcium level among HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	908	1.3	2.1	2.2	2.2	2.3	2.3	2.4
2022	852	2	2.1	2.2	2.2	2.3	2.3	2.5
2021	810	2	2.1	2.2	2.2	2.3	2.3	2.4
2020	779	1.5	2.1	2.2	2.2	2.3	2.3	2.5
2019	754	2	2.1	2.2	2.2	2.3	2.3	2.4
2018	735	1.9	2.1	2.2	2.2	2.3	2.3	2.4
2017	720	1.9	2.1	2.2	2.2	2.3	2.3	2.4
2016	696	1.8	2.1	2.2	2.2	2.3	2.3	2.4
2015	671	1.9	2.1	2.2	2.2	2.3	2.3	2.5
2014	643	1.9	2.1	2.2	2.2	2.3	2.3	2.5

Figure 7.2.5(a): Variation in median serum calcium level among HD patients, HD centres 2023

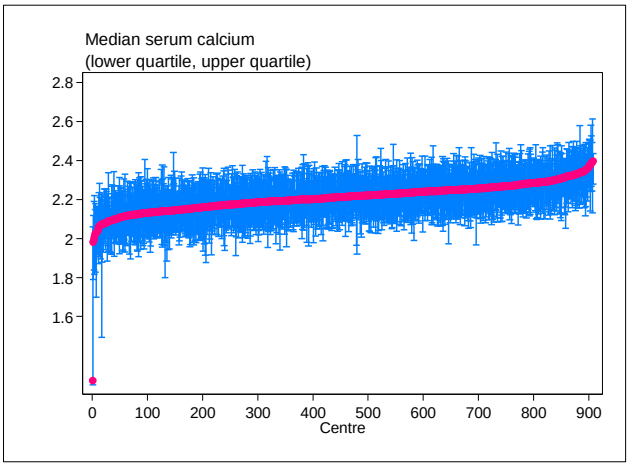


Figure 7.2.6(a): Variation in median serum calcium level among PD patients, PD centres 2023

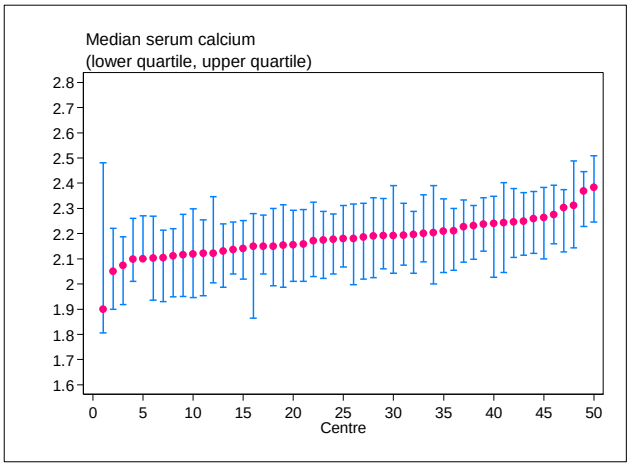


Table 7.2.6(a): Variation in corrected median serum calcium level among PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	50	1.9	2.1	2.1	2.2	2.2	2.3	2.4
2022	50	2	2.1	2.1	2.2	2.2	2.3	2.3
2021	46	2	2.1	2.1	2.2	2.3	2.3	2.4
2020	42	2	2.1	2.1	2.2	2.3	2.4	2.4
2019	39	1.9	2	2.1	2.2	2.3	2.3	2.4
2018	40	2	2	2.1	2.2	2.3	2.4	2.4
2017	38	1.9	2	2.1	2.2	2.3	2.3	2.4
2016	37	1.8	2	2.1	2.2	2.2	2.3	2.3
2015	35	1.7	1.9	2.1	2.2	2.2	2.4	2.4
2014	32	1.8	1.9	2.1	2.2	2.3	2.3	2.4

There was also large centre variation among the HD and PD centres with regards to the proportion of patients achieved the normal range of corrected serum calcium level (2.1 to 2.37mmol/L); it ranged from 16 to 91% for HD centres and 13 to 61% for PD centres in 2023. The median was 50% for HD centres and 44% for PD centres. The variation was smaller among PD centres compared to HD centres (Tables and Figures 7.2.5(b) & 7.2.6(b).

Table 7.2.5(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	908	16	36	44	50	56	67	91
2022	852	10	33	44	50	56	66	90
2021	810	6	32	42	48	55	66	86
2020	779	0	33	43	50	56	66	86
2019	754	8	32	43	50	57	66	81
2018	735	8	32	43	50	56	67	82
2017	720	9	33	42	49	56	66.5	90
2016	696	4	29	43	50	57	70	88
2015	671	13	32	43	50	58	70	88
2014	643	13	31	43	50	57	67	83

Figure 7.2.5(b): Variation in proportion of patients with serum calcium 2.1 to 2.37mmol/L, HD centres 2023

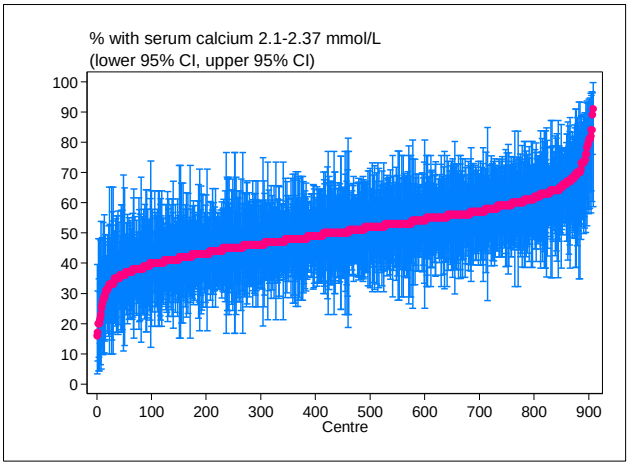


Figure 7.2.6(b): Variation in proportion of patients with serum calcium 2.1 to 2.37mmol/L, PD centres 2023

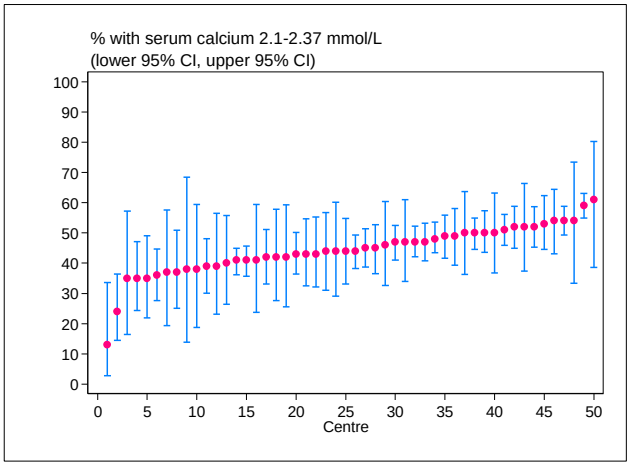


Table 7.2.6(b): Proportion of patients with serum calcium 2.1 to 2.37mmol/L, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	50	13	35	40	44	50	54	61
2022	50	28	33	42	46	52	60	61
2021	46	27	28	38	45.5	51	58	67
2020	42	27	31	38	43	51	57	62
2019	39	21	24	39	46	52	61	63
2018	40	13	25.5	38	47.5	52	63	70
2017	38	16	20	33	43	48	59	59
2016	37	0	23	36	45	53	60	64
2015	35	8	17	35	44	48	51	52
2014	32	18	23	38.5	46	52.5	57	61

The median serum phosphate level for HD centres was 1.7mmol/L (ranged from 1.1 to 2.4mmol/L) as opposed to median phosphate level of 1.7mmol/L (ranged from 1.4 to 2.0mmol/L) in PD centres. There was wide centre variation in serum phosphate level among HD and PD centres. Similarly, the variation was smaller among PD centres compared to HD centres (Tables and Figures 7.2.9(a) & 7.2.10(a).

Table 7.2.7(a): Variation in median serum phosphate level among HD centres, 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	911	1.1	1.5	1.6	1.7	1.8	2	2.4
2022	854	1.3	1.5	1.7	1.8	1.9	2	2.4
2021	816	1.3	1.5	1.7	1.8	1.9	2.1	2.4
2020	782	1.2	1.5	1.7	1.8	1.9	2.1	2.4
2019	754	1.3	1.5	1.6	1.7	1.9	2	2.3
2018	736	1.2	1.5	1.6	1.7	1.8	2	2.2
2017	721	0.7	1.5	1.6	1.7	1.8	2	2.3
2016	696	1.2	1.5	1.6	1.7	1.8	2	2.2
2015	671	1.1	1.5	1.6	1.7	1.8	2	2.3
2014	642	1.2	1.5	1.6	1.7	1.8	2	2.3

Figure 7.2.7(a): Variation in median serum phosphate level among HD patients, HD centres 2023

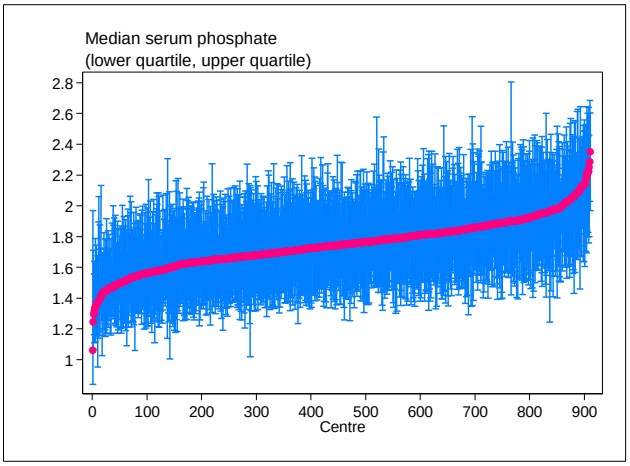


Figure 7.2.8(a): Variation in median serum phosphate level among PD patients, PD centres 2023

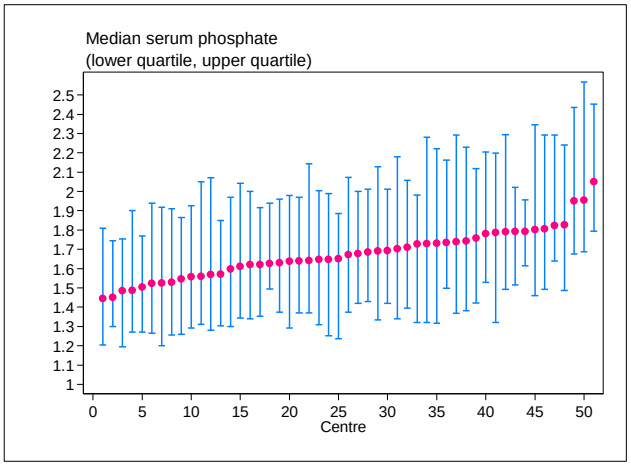


Table 7.2.8(a): Variation in median serum phosphate level among PD centres, 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	51	1.4	1.5	1.6	1.7	1.8	2	2
2022	49	1.4	1.4	1.6	1.7	1.8	2	2.3
2021	47	1.4	1.5	1.6	1.7	1.8	1.9	2
2020	43	1.4	1.5	1.6	1.7	1.8	2	2.1
2019	39	1.4	1.5	1.6	1.7	1.7	1.9	1.9
2018	40	1.4	1.5	1.5	1.7	1.7	1.9	1.9
2017	38	1.4	1.4	1.5	1.6	1.7	2	2
2016	37	1.4	1.4	1.5	1.6	1.7	1.9	1.9
2015	35	1.4	1.4	1.5	1.6	1.7	1.9	2
2014	32	1.4	1.4	1.5	1.6	1.8	1.9	2

There was also wide centre variation among the HD and PD centres with regards to the proportion of patients achieving the recommended serum phosphate level of 1.13 – 1.78 mmol/L; this ranged from 5 to 94% among HD centres (median 45%) and the range was narrower in PD centres, which was 17-62% (median 47%) in 2023 (Tables and Figures 7.2.7(b) & 7.2.7(b).

Table 7.2.7(b): Proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	911	5	26	38	45	51	63	94
2022	854	0	27	37	44	50	61	75
2021	816	9	24	35	42	49.5	63	100
2020	782	8	26	36	44	51	64	83
2019	754	8	26	38	45	52	65	91
2018	736	10	26	37	45	52	64	92
2017	721	8	27	39	45	53	71	95
2016	696	6	29	38	45	53	64	90
2015	671	0	29	40	46	53	64	93
2014	642	10	29	39	47	54	64	95

Figure 7.2.7(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres 2023

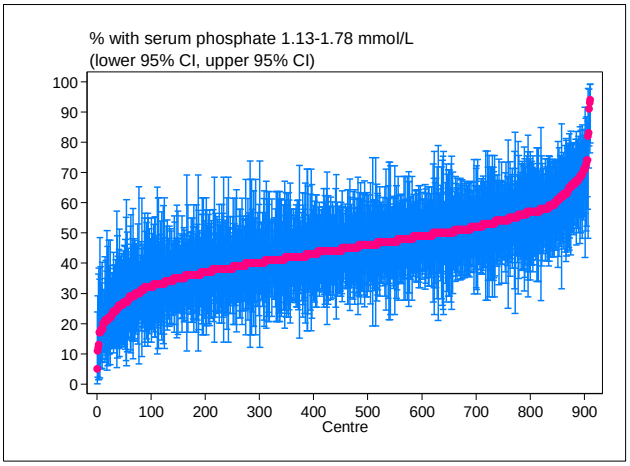


Figure 7.2.8(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 2023

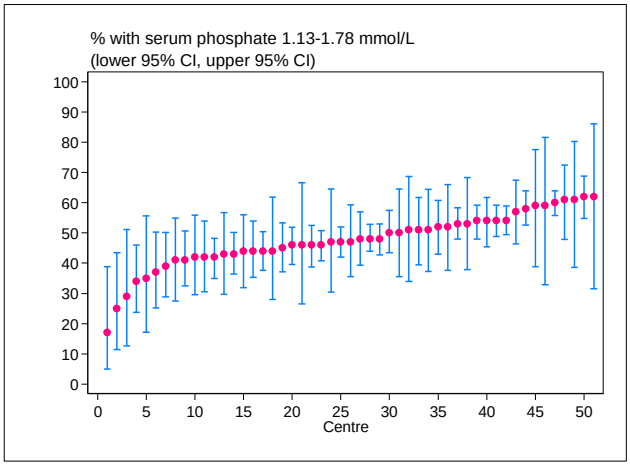


Table 7.2.8(b): Proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	51	17	29	43	47	54	61	62
2022	49	17	28	42	46	53	62	71
2021	47	16	38	42	45	50	55	61
2020	43	20	26	41	45	51	58	60
2019	39	30	32	44	48	53	60	68
2018	40	27	38	42	47	53.5	65.5	71
2017	38	20	26	42	48	54	63	63
2016	37	28	33	45	50	54	61	62
2015	35	17	35	46	52	57	70	74
2014	32	26	38	41.5	47	53.5	62	63

The proportion of patients with serum phosphate 0.8-1.3mmol/L was higher in PD patients with median of 20% as compared to 15% in HD patients in 2023. The centre variation ranged 0% to 51% for HD centres and 4% to 38% for PD centres (Tables and Figures 7.2.9c & 7.2.10c).

Table 7.2.7(c): Proportion of patients with serum phosphate 0.8-1.3 mmol/L, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	911	0	4	10	15	20	29	51
2022	854	0	4	10	15	20	29	47
2021	816	0	3	8	13	18	28	54
2020	782	0	3	8	13	18	28	64
2019	754	0	4	10	14	20	30	50
2018	736	0	4	10	15	20	32	71
2017	721	0	4	10	15	20	32	54
2016	696	0	4	10	15	22	32	53
2015	671	0	5	11	16	23	32	60
2014	642	0	5	11	17	23	33	49

Figure 7.2.7(c): Variation in proportion of patients with serum phosphate 0.8-1.3 mmol/L, HD centres 2023

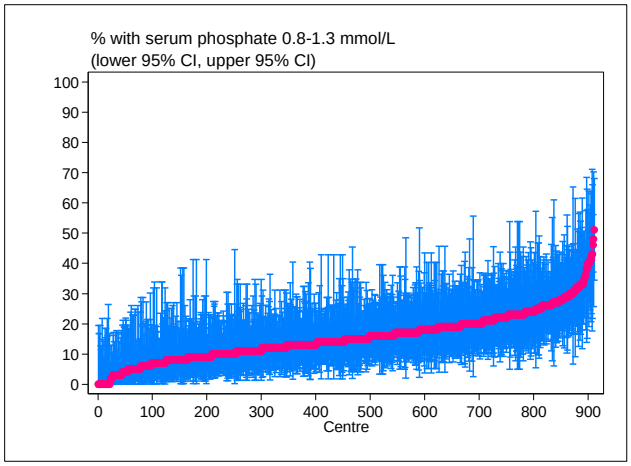


Figure 7.2.8(c): Variation in proportion of patients with serum phosphate 0.8-1.3 mmol/L, PD centres 2023

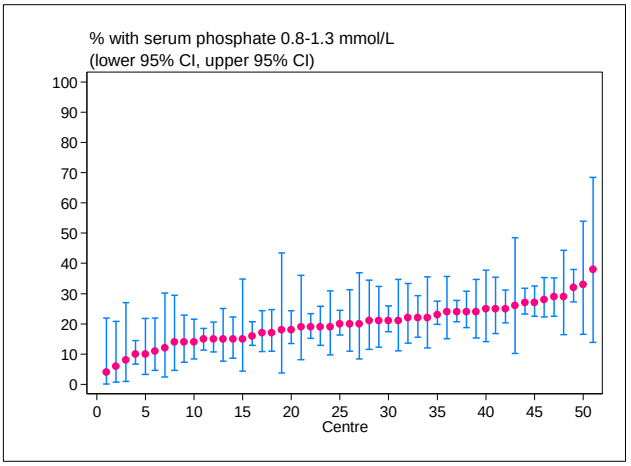


Table 7.2.8(c): Proportion of patients with serum phosphate 0.8-1.3 mmol/L, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	51	4	8	15	20	24	32	38
2022	49	0	6	14	19	23	36	38
2021	47	4	5	13	18	26	35	38
2020	43	0	6	13	20	25	36	39
2019	39	0	3	15	20	28	34	36
2018	40	0	8	15	21.5	27	38	43
2017	38	4	10	18	24	27	34	38
2016	37	0	5	18	22	27	36	39
2015	35	0	0	17	23	27	37	39
2014	32	2	4	15	22	28	38	39

SECTION 7.3: SERUM PARATHYROID HORMONE CONTROL

Calcitriol was the main vitamin D receptor activator (VDRA) used in treatment of hyperparathyroidism for both HD and PD patients. The percentage of patients on VDRA had increased in HD from 53% in 2014 to 67% in 2023. Similarly, the percentage of patients on VDRA in PD patients had increased from 37% in 2014 to 45% in 2023. Parathyroidectomy had remained stable at about 0-1% since 2014 in both HD and PD patients. (Tables 7.3.1 a & b) despite the increasing percentage of patients on calcimimetics.

Table 7.3.1(a): Treatment of hyperparathyroidism in HD patients, 2014-2023

Year	Number of patients	Vitamin D Receptor agonist		Number of patients on Calcimimetics		Number of Patients had Para-thyroidectomy	
		n	%	n	%	n	%
2023	52760	35160	67	2342	4	458	1
2022	50402	33416	66	2128	4	419	1
2021	49822	32332	65	2035	4	231	0
2020	47832	31404	66	1999	4	377	1
2019	44779	25174	56	458	1	389	1
2018	41796	23508	56	349	1	341	1
2017	40260	22931	57	256	1	408	1
2016	36505	20771	57	105	0	269	1
2015	33953	18747	55	90	0	243	1
2014	31353	16697	53	51	0	314	1

Table 7.3.1(b): Treatment of hyperparathyroidism in PD patients, 2014-2023

Year	Number of patients	Vitamin D Receptor agonist		Number of patients on Calcimimetics		Number of Patients had Para-thyroidectomy	
		n	%	n	%	n	%
2023	8100	3616	45	188	2	30	0
2022	7578	3437	45	162	2	38	1
2021	7181	3397	47	150	2	18	0
2020	6474	2882	45	128	2	35	1
2019	5884	2557	43	80	1	40	1
2018	5389	2314	43	53	1	24	0
2017	5021	2076	41	48	1	28	1
2016	4564	1712	38	28	1	26	1
2015	4235	1588	37	16	0	22	1
2014	3644	1342	37	3	0	27	1

HD patients had a mean iPTH of 157.2 pg/ml. 70% of HD patients had iPTH level <150pg/ml, 13% within the target level (>150&<300pg/ml) and 9% had iPTH above 500pg/ml. Mean iPTH was lower in diabetic HD patients than the non-diabetic HD patients (149.6pg/ml vs 164.6pg/ml). The diabetic HD patients had higher proportion with iPTH level below 150pg/ml (71%) than non-diabetic HD patients (68%). On the other hand, the mean iPTH in PD patients was 183pg/ml. 59% of PD patients had iPTH <150pg/ml, 19% achieved target iPTH (>150&<300pg/ml) and 9% had iPTH more than 500pg/ml. Similarly, mean iPTH was lower in diabetic PD patients than non-diabetic PD patients (159pg/ml vs 203.2pg/ml). The diabetic PD patients had higher proportion with iPTH level below 150pg/ml (63%) than non-diabetic PD patients (56%) (Tables and Figures 7.3.2b, 7.3.2c , 7.3.3b & 7.3.3c).

Table 7.3.2(a): Distribution of iPTH, HD patients 2014-2023

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & <300 pg/ml	≥300 & <500 pg/ml	≥500 pg/ml
2023	47137	157.2	203.9	66	29	201.8	70	13	9	9
2022	44454	165.1	211	68.3	29.8	217.1	68	13	9	9
2021	43306	164.7	211.2	68	28.6	218.5	68	13	10	9
2020	41713	178	220.4	75.5	31.8	244.6	66	13	10	11
2019	38926	181.5	219.8	80.6	33.2	251.4	64	14	10	11
2018	35391	185.4	224.4	80.8	32.8	262.8	64	14	11	11
2017	34343	201	229.4	94.9	36.2	299.6	60	15	12	13
2016	28082	205.8	232.8	97	36.1	313	59	15	13	13
2015	26353	239.1	242.6	143.2	43.6	374.4	51	17	15	16
2014	23730	230.9	240.6	133.8	40.3	359.8	52	18	15	15

Figure 7.3.2(a): Cumulative distribution of iPTH, HD patients 2014-2023

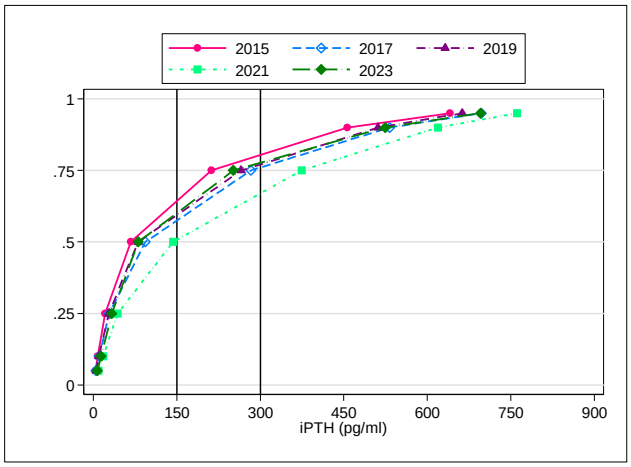


Figure 7.3.2(b): Cumulative distribution of iPTH, diabetic HD patients 2014-2023

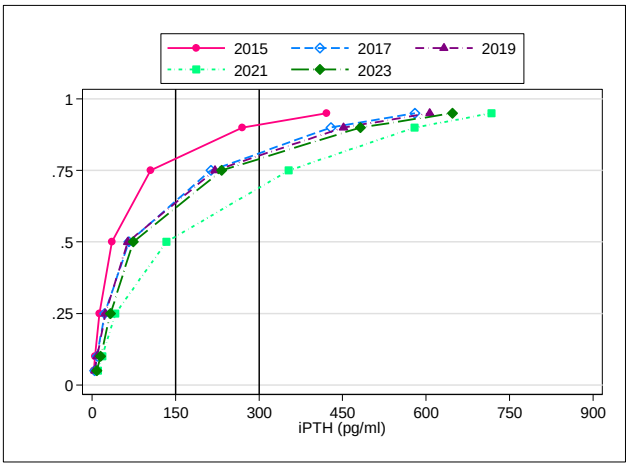


Table 7.3.2(b): Distribution of iPTH, diabetic HD patients, 2014-2023

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & <300 pg/ml	≥300 & <500 pg/ml	≥500 pg/ml
2023	23387	149.6	195.1	61.7	28.8	188.5	71	12	9	8
2022	22393	157.9	201.8	65	30	207	69	13	10	8
2021	22755	156.6	201.1	64	28.8	207.6	69	13	10	8
2020	22584	167.9	209.9	69.9	31.7	228.3	67	13	10	9
2019	21588	169.5	206.6	73.8	33	233	66	14	10	9
2018	19859	171.7	211.5	72.1	31.9	239.3	66	14	11	10
2017	19077	189.6	219.1	86	35.2	281.5	62	15	12	11
2016	15231	192.5	222.2	84.8	34.7	290	61	15	13	12
2015	13861	225.4	230.2	133.5	41.8	353.3	52	17	16	14
2014	12516	215.9	226.2	125	39	333.5	54	18	15	13

Table 7.3.2(c): Distribution of iPTH, non-diabetic HD patients, 2014-2023

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & <300 pg/ml	≥300 & <500 pg/ml	≥500 pg/ml
2023	23750	164.6	212	70.2	29.3	214.5	68	13	9	9
2022	22061	172.4	219.6	72.1	29.6	228.1	67	13	9	11
2021	20551	173.7	221.5	72.9	28.5	231.2	67	13	9	11
2020	19129	189.9	231.7	83.3	31.9	265.8	63	14	10	12
2019	17338	196.4	234.3	90.2	33.6	274.3	62	15	10	13
2018	15532	203	238.8	93.2	34.4	293.3	61	15	11	14
2017	15266	215.1	240.9	106.9	38.2	322.3	58	16	12	15
2016	12851	221.5	243.8	113	38.4	342.5	56	16	13	15
2015	12492	254.2	254.8	156.5	45.3	398	49	17	15	19
2014	11214	247.6	254.7	146	42.4	392.4	51	17	14	18

Figure 7.3.2(c): Cumulative distribution of iPTH, non-diabetic HD patients 2014-2023

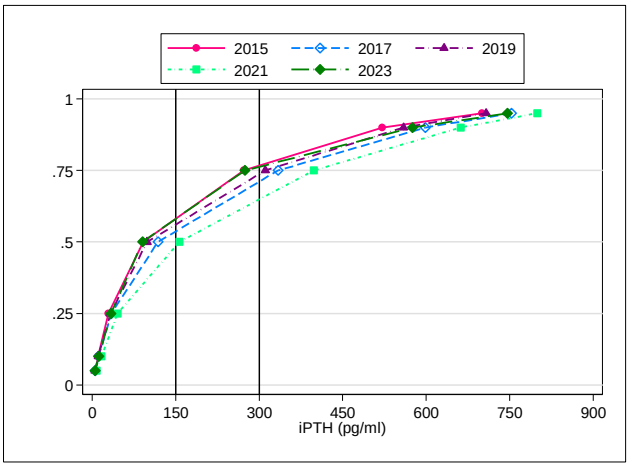


Figure 7.3.3(a): Cumulative distribution of iPTH, PD patients 2014-2023

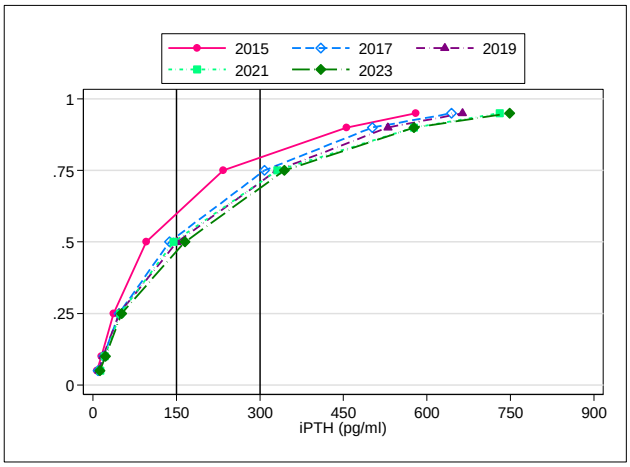


Table 7.3.3(a): Distribution of iPTH, PD patients 2014-2023

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & <300 pg/ml	≥300 & <500 pg/ml	≥500 pg/ml
2023	5697	183	206.7	98	32.4	262.3	59	19	12	9
2022	5265	175.1	202.6	93.5	29.8	249.6	61	20	11	8
2021	4958	194.1	212	114.6	35.1	283.7	57	20	13	10
2020	4487	232.7	225.9	160	49.6	351.5	48	22	16	13
2019	4515	235.9	228.7	165	51.1	344	48	22	17	13
2018	3967	230.1	222.8	159	47.9	339.1	48	22	17	13
2017	3861	221.7	218.9	153	49.4	315.9	49	24	15	12
2016	3541	246.8	224.6	181.5	67.5	359.5	44	24	18	14
2015	3378	226.3	225.8	145	48.5	331.5	51	20	15	14
2014	2860	235.7	219	167.3	57.8	347	47	22	18	14

Table 7.3.3(b): Distribution of iPTH, diabetic PD patients, 2014-2023

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & <300 pg/ml	≥300 & <500 pg/ml	≥500 pg/ml
2023	2605	159	182.3	83.5	30.6	225.1	63	20	10	6
2022	2391	153.2	179.7	81.2	28.3	213.4	64	19	10	6
2021	2337	181.2	200.3	105.5	33.3	262.2	59	20	13	8
2020	2183	217.1	209.5	151	48.3	317.5	50	23	16	11
2019	2272	207.4	203	140.5	47.9	302.2	52	23	16	9
2018	2011	190.6	190.4	127	41	281.2	54	23	15	8
2017	1962	190.5	191.2	136	44.3	268	54	26	13	8
2016	1821	214.7	197.8	152	63.5	306.5	49	25	16	10
2015	1718	191.7	197.4	118.6	43	274	56	22	13	9
2014	1429	203.9	192	141.8	51.5	301.6	52	23	16	9

Figure 7.3.3(b): Cumulative distribution of iPTH, diabetic PD patients, 2014-2023

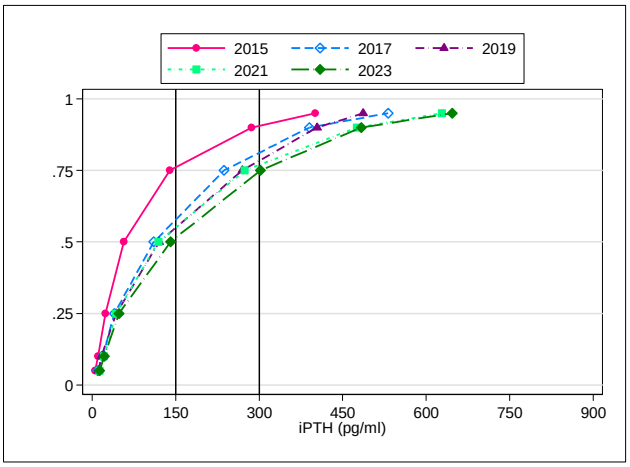


Figure 7.3.3(c): Cumulative distribution of iPTH, non-diabetic PD patients, 2014-2023

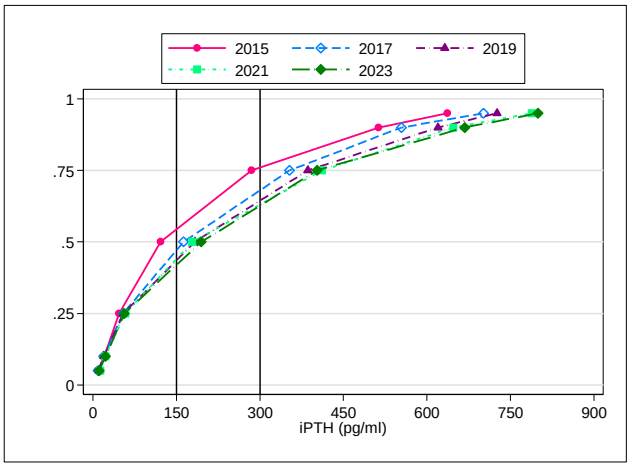


Table 7.3.3(c): Distribution of iPTH, non-diabetic PD patients, 2014-2023

Year	Number of Patients	Mean	SD	Median	LQ	UQ	Percent patients with iPTH:			
							<150 pg/ml	≥150 & <300 pg/ml	≥300 & <500 pg/ml	≥500 pg/ml
2023	3092	203.2	223.3	114.1	34.5	302.3	56	19	14	11
2022	2874	193.4	218.2	107.6	30.7	281.4	58	20	12	10
2021	2621	205.6	221.3	122.5	36.2	302.4	55	20	14	11
2020	2304	247.5	239.5	169.8	50.8	376.6	47	20	17	16
2019	2243	264.7	248.9	194.5	56	402.5	44	21	18	17
2018	1956	270.7	245.3	204.8	61.1	414.5	42	21	19	18
2017	1899	254	240.1	181	57	380	45	22	17	16
2016	1720	280.8	245.5	217.9	73	422	39	23	19	19
2015	1660	262.1	246.8	178.5	57.8	411.6	46	19	16	19
2014	1431	267.5	238.9	196	66	420.5	42	20	19	18

There was wide variation in iPTH level among HD centres and PD centres. The degree of variation seemed to become wider since 2012 in PD centres but improved among HD centres (Tables and Figures 7.3.4a & 7.3.5a). The median for the proportion of patients with serum iPTH level in the range 150-300 pg/ml was 10% for HD centres and 23% for PD centres (Tables and Figures 7.3.4b & 7.3.5b).

Table 7.3.4(a): Variation in iPTH among HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	898	11.3	26.9	40.6	55.5	178.5	356.4	559.6
2022	840	11	25.5	41.3	59.7	200.6	383.1	565.6
2021	800	12.7	26.3	40	56.8	208	357.8	511
2020	770	10	29.4	43.6	62.3	217.4	366.7	675.8
2019	736	8.4	28.7	45.2	68.2	222.2	362.7	562.4
2018	718	7.8	27.9	44	65	242.5	388.5	574.2
2017	694	10.8	30.3	47.2	85.5	251	380.6	562.4
2016	644	18	28.9	47.8	102	244.5	411.7	580.7
2015	623	11.3	31.2	69.9	176.2	277.4	386.5	667.1
2014	583	11.6	29.5	56	154.3	259.5	379.6	569

Figure 7.3.4(a): Variation in median iPTH among HD patients, HD centres, 2023

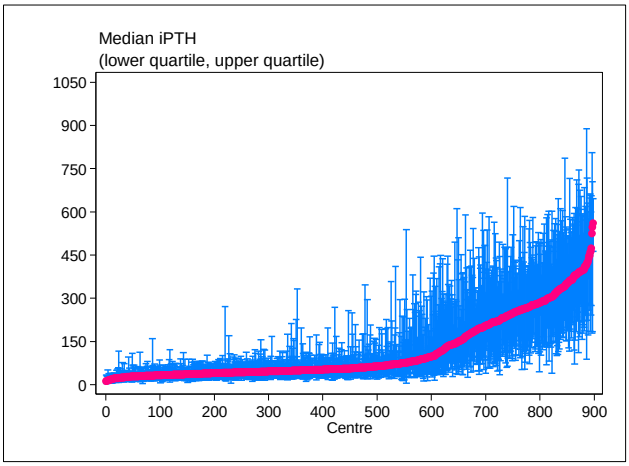


Figure 7.3.4(b): Variation in proportion of patients with iPTH 150-300pg/ml, HD centres, 2022

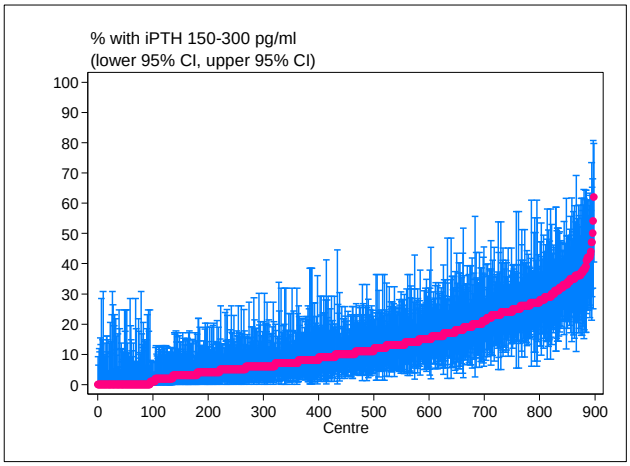


Table 7.3.4(b): Variation in proportion of patients with iPTH 150-300pg/ml, HD centres, 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	898	0	0	5	10	19	34	62
2022	840	0	0	5	11	20	33	52
2021	800	0	0	5	10	20	32.5	55
2020	770	0	0	6	12	20	31	49
2019	736	0	0	6	13	21	31	55
2018	718	0	0	6	12	21	31	53
2017	694	0	0	7	14	21	31	52
2016	644	0	0	7	14	22	32	50
2015	623	0	0	10	17	24	33	56
2014	583	0	2	10	17	24	33	54

Table 7.3.5(a): Variation in median iPTH among PD patients 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	49	16.8	22.6	42.9	155.6	230	357	364.1
2022	47	17.9	21.6	44.7	171.6	228.3	290.5	451.6
2021	46	14.2	25.1	41.9	186.9	255.5	338.5	410
2020	42	20.6	31.7	94.7	204.4	242.5	394.3	438.6
2019	39	15.7	34.6	93.5	230	298.7	425.9	445.3
2018	34	21.6	31.8	124	216.4	294.9	383	424
2017	35	34.5	35.2	95.8	182.5	252.4	473	503.4
2016	35	38.7	69	133.5	208.8	285.9	419	420.2
2015	34	35	42	99.4	201.4	289.5	452.8	490.5
2014	29	40.2	41	107.9	209.5	298.5	374.5	376.9

Figure 7.3.5(a): Variation in median iPTH among PD patients, PD centres, 2023

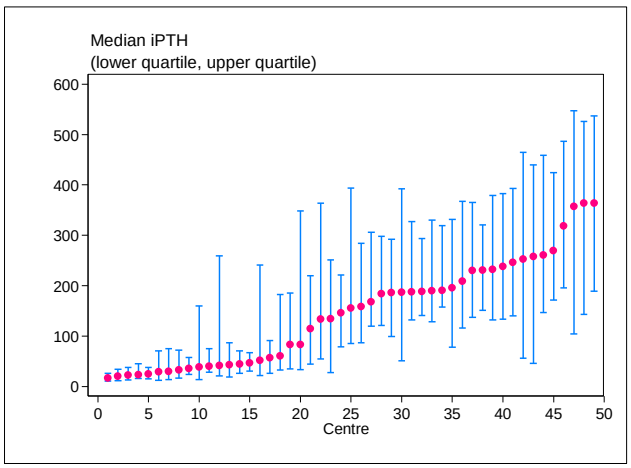


Figure 7.3.5(b): Variation in proportion of patients with iPTH 150-300pg/ml, PD centres 2023

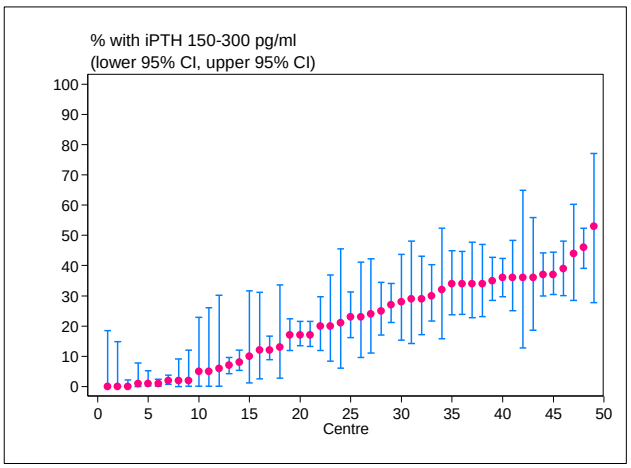


Table 7.3.5(b): Variation in proportion of patients with iPTH 150-300pg/ml, PD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	49	0	0	7	23	34	44	53
2022	47	0	0	7	23	35	44	50
2021	46	0	2	12	24	30	41	46
2020	42	0	0	13	23	27	33	53
2019	39	0	5	13	23	28	36	40
2018	34	0	6	13	22	27	35	42
2017	35	3	4	15	24	33	39	41
2016	35	4	9	16	24	27	35	40
2015	34	0	0	14	19	29	36	43
2014	29	0	6	13	21	26	32	42

Conclusion

Chronic Kidney Disease–Mineral and Bone Disorder (CKD-MBD) remains a prevalent and clinically significant complication in the dialysis population, contributing to increased cardiovascular morbidity and mortality. As outlined in KDIGO guidelines, CKD-MBD encompasses biochemical abnormalities (serum calcium, phosphate, and iPTH), bone disorders, and vascular calcification. However, in Malaysia, disease assessment is limited to biochemical markers, as bone biopsies and vascular imaging are not routinely performed.

Analysis of national data from 2014 to 2023 indicates a gradual improvement in laboratory parameters, alongside increased use of non-calcium-based phosphate binders and calcimimetics. Despite these advances, calcium-based phosphate binders and activated vitamin D analogues continue to represent the main therapeutic approaches. Diabetic dialysis patients consistently exhibit lower iPTH levels than non-diabetics, likely due to a higher prevalence of adynamic bone disease—a condition associated with reduced bone turnover and diminished parathyroid hormone secretion.

Parathyroidectomy has remained stable at approximately 1% of haemodialysis patients since 2014. This ongoing reliance on surgery reflects, in part, the limited accessibility of calcimimetics such as cinacalcet, which are often restricted due to their high cost. As a result, parathyroidectomy remains a necessary option in cases of severe or treatment-resistant tertiary hyperparathyroidism, especially when medical management fails.

Despite observed progress, the overall control of calcium, phosphate, and iPTH remains suboptimal, with considerable variation between centres—most notably in haemodialysis settings. These disparities highlight the pressing need for a coordinated national strategy to standardise CKD-MBD care, improve access to advanced therapies, and promote adherence to clinical guidelines to enhance outcomes for the dialysis population.

CHAPTER 8

HAEMODIALYSIS PRACTICES

Shahnaz Shah Firdaus Khan
Leong Chong Men (Bryan)

SECTION 8.1: VASCULAR ACCESS AND ITS COMPLICATIONS

The proportion of patients undergoing haemodialysis (HD) using a fistula has been consistently and gradually reducing for the past 10 years. It was 86.1% in 2014 and was only 75.7% in 2023. This is most likely caused by a significant proportion of incident dialysis cases not having a functioning fistula upon initiation of HD, and the increasing number of elderly and diabetic patients without permanent vascular access, dialysing with dialysis catheters. There is no doubt that creating wrist AVF is more challenging among elderly and diabetic patients with small vessels. The number of patients undergoing HD using BCF has overtaken those using wrist AVF since 2022.

The development of interventional nephrology has brought an increase in patients undergoing HD via cuffed-HD catheters and non-cuffed catheters. The number of patients undergoing HD via cuffed-HD catheters has overtaken the number of patients using non-cuffed HD catheters in 2023, i.e., 12.2% vs 11.3%.

Table 8.1.1: Vascular access on haemodialysis, 2014-2023

Access types	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Wrist AVF*	18346	34	17907	35.8	19073	37.6	19562	39.5	19657	41.4
BCF*	20443	37.9	18851	37.7	19093	37.6	18499	37.4	17783	37.5
BBF*	2049	3.8	1801	3.6	1740	3.4	1615	3.3	1526	3.2
Graft	421	0.8	444	0.9	448	0.9	490	1	527	1.1
HD Catheter – Cuffed	6575	12.2	5512	11	5187	10.2	4542	9.2	3812	8
HD Catheter – Non-Cuffed	6100	11.3	5488	11	5238	10.3	4810	9.7	4144	8.7
Total	53934	100	50003	100	50779	100	49518	100	47449	100

Access types	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Wrist AVF*	19176	42.8	18905	44.1	17997	44.9	16121	46.9	15540	48.8
BCF*	16751	37.4	16205	37.8	14956	37.3	12546	36.5	11222	35.2
BBF*	1340	3	1184	2.8	950	2.4	784	2.3	665	2.1
Graft	567	1.3	576	1.3	557	1.4	551	1.6	559	1.8
HD Catheter – Cuffed	3313	7.4	3028	7.1	2662	6.6	1947	5.7	1672	5.3
HD Catheter – Non-Cuffed	3605	8.1	3011	7	2971	7.4	2398	7	2182	6.9
Total	44752	100	42909	100	40093	100	34347	100	31840	100

**AVF = arteriovenous fistula, BBF = brachiobasilic fistula, BCF = brachiocephalic fistula*

There was no increase in difficulties reported with vascular access.

Table 8.1.2: Difficulties reported with vascular access, 2014-2023

Access difficulty	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Difficulty with needle placement	706	1.3	672	1.4	748	1.5	870	1.8	404	1.1
Difficulty in obtaining desired blood flow rate	804	1.5	815	1.7	939	1.9	1138	2.4	516	1.4
Other difficulties	211	0.4	225	0.5	242	0.5	274	0.6	68	0.2
No difficulties	51891	96.8	47451	96.5	47510	96.1	46081	95.3	35036	97.3
Total	53612	100	49163	100	49439	100	48363	100	36024	100

Access difficulty	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Difficulty with needle placement	360	1.2	513	2	547	1.5	554	1.7	656	2.2
Difficulty in obtaining desired blood flow rate	419	1.4	517	2.1	495	1.4	470	1.4	488	1.6
Other difficulties	49	0.2	71	0.3	82	0.2	74	0.2	78	0.3
No difficulties	29661	97.3	23961	95.6	35230	96.9	32371	96.7	29288	96
Total	30489	100	25062	100	36354	100	33469	100	30510	100

Complication risk remains less than 7% for the past 9 years, and the 3 commonest complications were aneurysmal dilatation, venous outflow obstruction and thrombosis of fistula.

Table 8.1.3: Complications reported with vascular access, 2014-2023

Complication	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Thrombosis	318	0.6	256	0.5	440	0.9	541	1.1	196	0.5
Bleed	121	0.2	102	0.2	111	0.2	144	0.3	48	0.1
Aneurysmal dilatation	660	1.2	612	1.2	642	1.3	680	1.4	56	0.2
Swollen limb	188	0.4	177	0.4	185	0.4	227	0.5	74	0.2
Access related infection, local/systemic	158	0.3	149	0.3	230	0.5	263	0.5	105	0.3
Distal limb ischaemia	23	0.0	35	0.1	41	0.1	30	0.1	9	0
Venous outflow obstruction	540	1.0	565	1.1	604	1.2	593	1.2	184	0.5
Carpal tunnel	27	0.1	25	0.1	29	0.1	26	0.1	4	0
Others	299	0.6	313	0.6	315	0.6	402	0.8	102	0.3
No complications	51376	95.7	47071	95.5	46995	94.8	45576	94	35128	97.8
Total	53710	100	49305	100	49592	100	48482	100	35906	100

Complication	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Thrombosis	184	0.6	387	1.5	576	1.6	551	1.6	552	1.8
Bleed	53	0.2	70	0.3	79	0.2	66	0.2	84	0.3
Aneurysmal dilatation	58	0.2	369	1.5	511	1.4	488	1.4	520	1.7
Swollen limb	65	0.2	116	0.5	160	0.4	159	0.5	200	0.6
Access related infection, local/systemic	133	0.4	167	0.7	205	0.6	189	0.6	181	0.6
Distal limb ischaemia	11	0	24	0.1	37	0.1	49	0.1	33	0.1
Venous outflow obstruction	127	0.4	315	1.3	385	1.1	367	1.1	425	1.4
Carpal tunnel	2	0	24	0.1	42	0.1	35	0.1	41	0.1
Others	69	0.2	158	0.6	172	0.5	171	0.5	210	0.7
No complications	29682	97.7	23531	93.5	34267	94.1	32206	93.9	28989	92.8
Total	30384	100	25161	100	36434	100	34281	100	31235	100

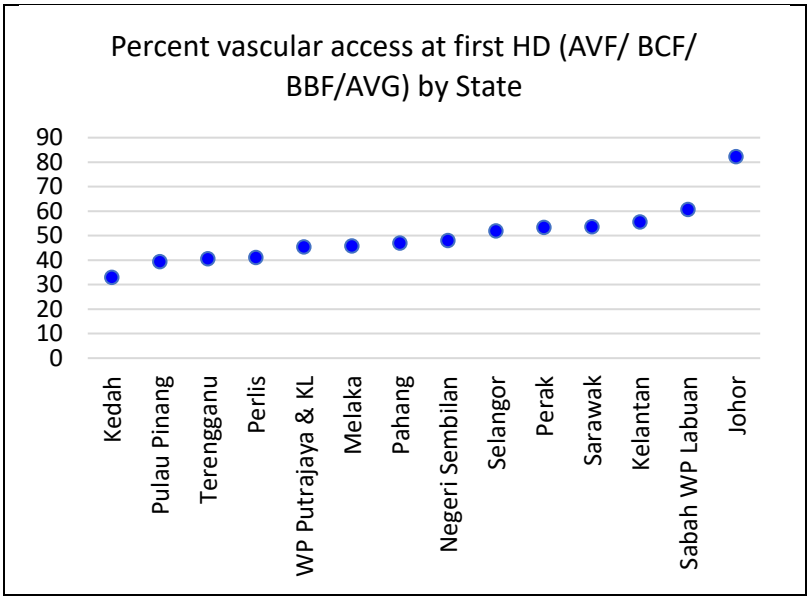
Table 8.1.4: Percent vascular access at first HD (Fistual+AVG) of all HD starts by State in Malaysia, 1 January 2023 - 31st December 2023

State	Fistula	AVG	Temporary catheter	Permcath	Unknown	Total	% (Fistula + AVG)/ Total	% Catheters
Malaysia	4307	21	2577	987	258	8150	53.1	43.7
Kedah	221	0	336	90	22	669	33	63.7
Pulau Pinang	219	1	227	76	35	558	39.4	54.3
Terengganu	125	0	127	47	9	308	40.6	56.5
Perlis	23	0	19	8	6	56	41.1	48.2
WP Putrajaya & KL	267	3	190	112	22	594	45.5	50.8
Melaka	152	0	132	44	3	331	45.9	53.2
Pahang	191	2	181	29	8	411	47	51.1
Negeri Sembilan	176	1	145	38	8	368	48.1	49.7
Selangor	845	9	526	231	31	1642	52	46.1
Perak	369	0	203	105	14	691	53.4	44.6
Sarawak	292	0	155	63	34	544	53.7	40.1
Kelantan	254	1	143	51	10	459	55.6	42.3
Sabah WP Labuan	205	2	94	20	20	341	60.7	33.4
Johor	968	2	99	73	36	1178	82.3	14.6

Fistula = AVF + BBF + BCF
Temporary catheter = non cuffed catheter
Permcath = Cuffed catheter

In year 2023, 53.1% of patients started HD via fistula or AVG in Malaysia. The states of Kedah and Pulau Pinang recorded the lowest number of patients starting HD via fistula or AVG (<40%). The state of Johor did well, with 82.3% of patients initiating HD via fistula or AVG. Other states in Malaysia ranged between 40-60%.

Figure 8.1.4: Percent vascular access at first HD (Fistula+AVG) of all HD starts by State in Malaysia, 1 January 2023 - 31st December 2023



SECTION 8.2: HD PRESCRIPTION

More than 90% of the patients were undergoing HD with the blood flow rate of >250ml/min for the past 10 years. Majority of the patients were being dialysed with Qb 300-349ml/min.

Table 8.2.1: Blood flow rates in HD centres, 2014-2023

Blood flow rates	2023		2022		2021		2020		2019	
(ml/min)	n	%	n	%	n	%	n	%	n	%
<150	35	0.1	16	0.1	16	0.1	9	0	14	0.1
150-199	383	0.7	177	0.6	265	0.9	262	1	204	0.8
200-249	3529	6.5	1470	4.7	2118	6.9	1950	7.4	1601	6.5
250-299	18193	33.7	8171	26.4	9905	32.2	8247	31.4	7069	28.8
300-349	24545	45.5	15255	49.2	13960	45.3	11787	44.9	11449	46.6
≥350	7273	13.5	5920	19.1	4540	14.7	3976	15.2	4220	17.2
Total	53958	100	31009	100	30804	100	26231	100	24557	100

Blood flow rates	2018		2017		2016		2015		2014	
(ml/min)	n	%	n	%	n	%	n	%	n	%
<150	18	0.1	30	0.1	51	0.1	24	0.1	23	0.1
150-199	239	1.2	185	0.8	278	0.8	216	0.6	164	0.5
200-249	1460	7.2	1621	6.9	2133	5.8	1878	5.5	1703	5.4
250-299	6255	30.8	7206	30.9	9674	26.2	8557	25	8088	25.6
300-349	8788	43.2	9635	41.3	15716	42.6	14515	42.4	13081	41.4
≥350	3575	17.6	4658	20	9017	24.5	9062	26.5	8532	27
Total	20335	100	23335	100	36869	100	34252	100	31591	100

More than 97% of the HD patients had 3 sessions of HD per week for the past 10 years. Besides, >98% of them were dialysed for 4 hours during each session.

Table 8.2.2: Number of HD sessions per week, 2014-2023

HD sessions	2023		2022		2021		2020		2019	
per week	n	%	n	%	n	%	n	%	n	%
1	100	0.2	54	0.2	39	0.1	88	0.3	122	0.5
2	1033	1.9	321	1	545	1.8	502	1.9	452	1.8
3	52607	97.5	30519	98.4	30061	97.6	25555	97.4	23858	97.4
4	210	0.4	108	0.3	159	0.5	85	0.3	67	0.3
≥5	2	0	0	0	0	0	1	0	2	0
Total	53952	100	31002	100	30804	100	26231	100	24501	100

HD sessions	2018		2017		2016		2015		2014	
per week	n	%	n	%	n	%	n	%	n	%
1	62	0.3	75	0.3	67	0.2	16	0	33	0.1
2	441	2.2	528	2.3	479	1.3	466	1.4	528	1.7
3	19762	97.3	22644	97	36232	98	33709	98.1	31018	97.7
4	53	0.3	84	0.4	165	0.4	132	0.4	138	0.4
≥5	1	0	4	0	13	0	43	0.1	44	0.1
Total	20319	100	23335	100	36956	100	34366	100	31761	100

Table 8.2.3: Duration of HD, 2014-2023

Duration of HD per session (hours)	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
≤3	364	0.7	169	0.5	214	0.7	146	0.6	112	0.5
3.5	194	0.4	95	0.3	172	0.6	82	0.3	89	0.4
4	53341	98.9	30702	99	30389	98.7	25959	99	24252	99
4.5	47	0.1	35	0.1	22	0.1	38	0.1	33	0.1
5	7	0	1	0	7	0	5	0	8	0
>5	0	0	0	0	0	0	1	0	0	0
Total	53953	100	31002	100	30804	100	26231	100	24494	100

Duration of HD per session (hours)	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
≤3	74	0.4	117	0.5	183	0.5	121	0.4	113	0.4
3.5	41	0.2	72	0.3	88	0.2	78	0.2	83	0.3
4	20161	99.2	23133	99	36614	99.1	34085	99.2	31479	99.1
4.5	34	0.2	44	0.2	53	0.1	62	0.2	39	0.1
5	9	0	12	0.1	23	0.1	27	0.1	40	0.1
>5	1	0	0	0	3	0	3	0	3	0
Total	20320	100	23378	100	36964	100	34376	100	31757	100

Synthetic membrane type remained the preferred choice for most HD centres compared to other membrane types.

Table 8.2.4: Dialyser membrane types in HD centres, 2014-2023

Dialyser membrane	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Cellulosic membranes	981	1.8	931	3	1021	3.3	717	2.7	914	3.6
Synthetic membranes	44872	83	25982	83.3	25349	82.2	21806	83.1	20931	82.9
Unknown	8233	15.2	4291	13.8	4434	14.4	3708	14.1	3404	13.5
Total	54086	100	31204	100	30804	100	26231	100	25249	100

Dialyser membrane	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Cellulosic membranes	1069	5.1	1623	6.6	3194	1069	5.1	1623	6.6	3194
Synthetic membranes	17324	83	18707	75.8	25189	17324	83	18707	75.8	25189
Unknown	2493	11.9	4366	17.7	8657	2493	11.9	4366	17.7	8657
Total	20886	100	24696	100	37040	20886	100	24696	100	37040

Single use dialyser is getting more popular over the past 10 years, increasing steadily from 13.1% in 2014 to 30.3% in 2023.

Table 8.2.5: Dialyser reuse frequency in HD centres, 2014-2023

Dialyser reuse	2023		2022		2021		2020	
frequency	n	%	n	%	n	%	n	%
Single use	13701	30.3	5743	24.8	6581	23.8	5583	23.8
Reuse	31504	69.7	17445	75.2	21056	76.2	17827	76.2
Total	45205	100	23188	100	27637	100	23410	100

Dialyser reuse	2019		2018		2017		2016		2015		2014	
frequency	n	%	n	%	n	%	n	%	n	%	n	%
Single use	4437	19.5	3716	19.1	3662	16.3	4730	13.8	4711	14.5	3919	13.1
2	17	0.1	8	0	26	0.1	136	0.4	51	0.2	34	0.1
3	85	0.4	92	0.5	137	0.6	410	1.2	220	0.7	165	0.6
4	42	0.2	41	0.2	58	0.3	171	0.5	109	0.3	93	0.3
5	142	0.6	85	0.4	159	0.7	517	1.5	270	0.8	180	0.6
6	355	1.6	379	2	339	1.5	897	2.6	760	2.3	683	2.3
7	200	0.9	263	1.4	210	0.9	459	1.3	436	1.3	582	1.9
8	1284	5.6	825	4.2	1006	4.5	1632	4.8	1439	4.4	1580	5.3
9	116	0.5	30	0.2	64	0.3	96	0.3	167	0.5	170	0.6
10	2707	11.9	2230	11.5	2945	13.1	4474	13	4630	14.2	4238	14.1
11	55	0.2	51	0.3	42	0.2	120	0.3	106	0.3	103	0.3
12	6799	29.9	4932	25.4	7112	31.7	10038	29.3	9641	29.6	9112	30.4
≥13	6508	28.6	6769	34.9	6645	29.7	10611	30.9	10047	30.8	9124	30.4
Total	22747	100	19421	100	22405	100	34291	100	32587	100	29983	100

The mean and median delivered Kt/V was 1.5 in year 2023. Seventy two percent of the patients had a delivered Kt/V of at least 1.3 in 2023.

Table 8.2.6(a): Distribution of delivered Kt/V, HD patients 2019-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients ≥1.2	% patients ≥1.3
2023	51102	1.5	0.3	1.5	1.3	1.7	85	72
2022	48626	1.5	0.3	1.5	1.3	1.7	85	72
2021	47980	1.5	0.3	1.5	1.3	1.7	83	69
2020	45758	1.5	0.3	1.5	1.3	1.7	85	72
2019	42764	1.6	1.4	1.5	1.3	1.7	87	75

The mean and median Urea reduction ratio (URR) was 70.5 and 71.1 respectively in 2023. Fifty six percent of patient achieved URR ≥ 70%.

Table 8.2.6(b): Distribution of URR, HD patients 2019-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients ≥ 65%	% patients ≥ 70%
2023	51102	70.5	7.7	71.1	65.8	76	78	56
2022	48626	70.5	7.8	71.2	65.9	76	78	56
2021	47980	69.9	8	70.6	65.2	75.5	76	53
2020	45758	70.6	7.9	71.3	65.9	76.2	78	56
2019	42747	71.1	8	71.7	66.4	76.6	80	59

The median blood flow rates in HD centres remain the same for the past 10 years, i.e. 300ml/min. The minimum blood flow rate remains less than 200ml/min for the past 4 years.

Table 8.2.7(a): Variation in median blood flow rates in HD patients, HD centres, 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	918	150	250	260	300	300	350	400
2022	736	180	250	280	300	300	350	400
2021	726	150	250	260	300	300	350	400
2020	663	150	250	260	300	300	350	400
2019	633	200	250	280	300	300	350	400
2018	591	200	250	250	300	300	350	400
2017	631	200	250	280	300	300	350	400
2016	699	180	250	300	300	320	350	400
2015	677	150	250	300	300	330	350	400
2014	647	170	250	300	300	335	375	400

Figure 8.2.7(a): Variation in median blood flow rates in HD patients among centres 2023

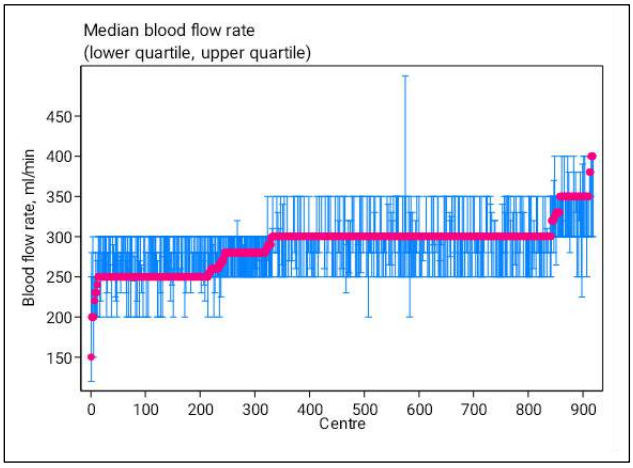
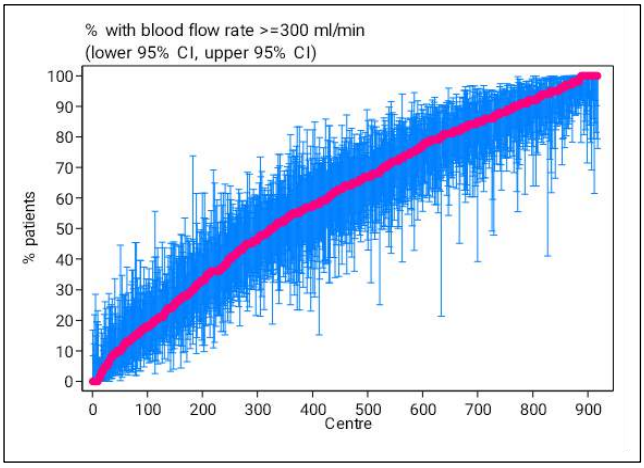


Figure 8.2.7(b): Variation in Proportion of patients with blood flow rates ≥ 300 ml/min among HD centres 2023



There was one centre with median blood flow rate of <= 200mls/min. There was a wide variation in the proportion of patients with a blood flow rate of >= 300ml/min. There were centres with none of their patients with a blood flow rate of >= 300ml/min.

The median for the proportion of patients with blood flow rates of >= 300 ml/min in centres had dropped to 64 in 2023 from 76 in 2022.

Table 8.2.7(b): Proportion of patients with blood flow rates ≥ 300 ml/min, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	918	0	10	36	64	84	98	100
2022	736	0	16	49	76	90	100	100
2021	726	0	7	36	64	85	98	100
2020	663	0	9	39	66	84	98	100
2019	633	0	11	42	69	86	100	100
2018	591	0	6	39	66	87	100	100
2017	631	0	11	47	70	88	100	100
2016	699	0	19	55	78	92	100	100
2015	677	0	22	58	78	91	100	100
2014	647	0	21	58	77	90	100	100

The majority of centres had 100% of their patients with 3 HD sessions/week. There were a few centres with less than 60% of their patients on 3 HD sessions per week.

Table 8.2.7(c): Proportion of patients with 3 HD sessions per week, HD centres 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	918	55	88	98	100	100	100	100
2022	736	42	91	99	100	100	100	100
2021	726	6	86	98	100	100	100	100
2020	663	34	88	98	100	100	100	100
2019	632	0	87	98	100	100	100	100
2018	591	30	86	99	100	100	100	100
2017	629	39	88	97	100	100	100	100
2016	699	17	92	98	100	100	100	100
2015	677	50	92	98	100	100	100	100
2014	647	20	90	98	100	100	100	100

Figure 8.2.7(c): Variation in proportion of patients with 3 HD sessions per week among HD centres 2023

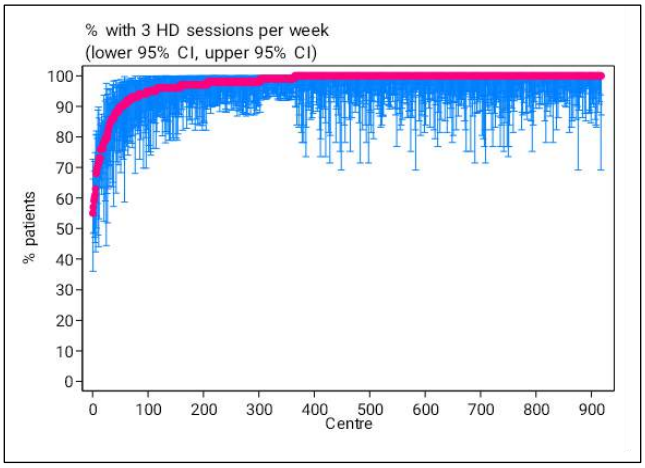
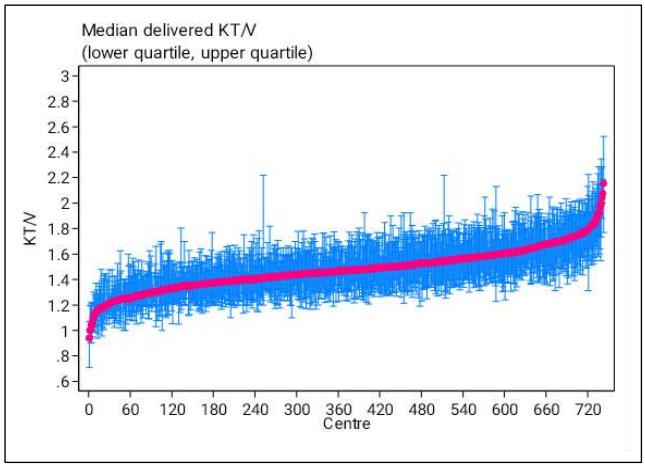


Figure 8.2.7(d): Variation in median delivered Kt/V in HD patients among HD centres 2023



The median delivered Kt/V was 1.5. The median delivered Kt/V in HD patients among HD centres in 2023 ranged from 0.9 to 2.2. Half of the centres had 88% of their patients with a delivered Kt/V ≥1.2 in 2023. There was one centre with less than 10% of their patients with a delivered Kt/V ≥1.2.

Table 8.2.7(d): Median delivered Kt/V in HD patients, HD centres 2019-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	743	0.9	1.2	1.4	1.5	1.6	1.7	2.2
2022	691	1	1.2	1.4	1.5	1.6	1.8	2.1
2021	653	1	1.2	1.4	1.5	1.6	1.7	3
2020	611	1.1	1.2	1.4	1.5	1.6	1.8	2.1
2019	581	1.1	1.3	1.4	1.5	1.6	1.8	4

Table 8.2.7(e): Proportion of patients with delivered Kt/V ≥1.2, HD centres 2019-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	743	8	56	78	88	93	100	100
2022	691	15	60	79	88	94	100	100
2021	653	24	53	76	85	93	100	100
2020	611	26	58	79	88	94	100	100
2019	581	20	64	82	90	95	100	100

Figure 8.2.7(e): Variation in proportion of patients with delivered Kt/V ≥1.2, HD centres 2023

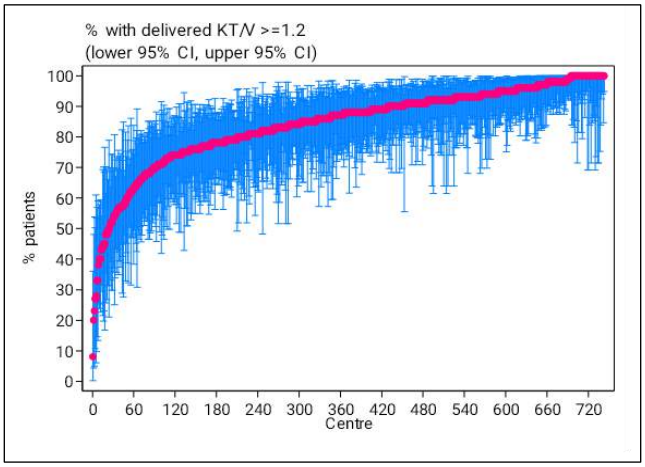
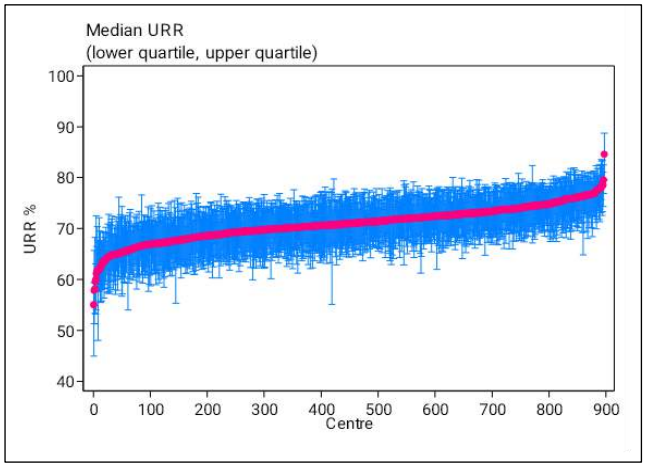


Figure 8.2.7(f): Variation in median URR among HD patients, HD centres 2023



The median URR for 2023 was 71%. The median URR in HD patients among HD centres in 2023 range from 55.1 to 84.6. Half of the centres had 80% of their patients with URR ≥65%. There was one centre with less 10% of their patients with URR ≥65%.

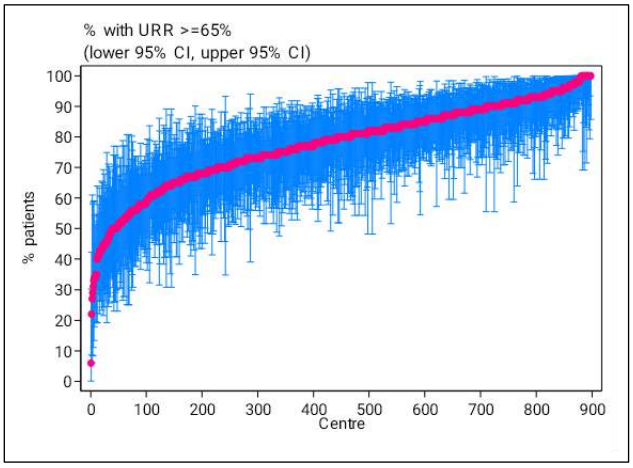
Table 8.2.7(f): Median URR among HD patients, HD centres 2019-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	897	55.1	65.1	68.9	71	73.1	76.2	84.6
2022	837	59.7	65.3	68.7	71.1	73.3	76	82.6
2021	798	58	64.5	68.3	70.6	72.6	76	81.3
2020	764	58.8	64.6	68.6	71.1	73.7	76.8	81.3
2019	741	60	65.7	69.5	71.6	73.9	76.8	95.8

Table 8.2.7(g): Proportion of HD patients with URR ≥65%, HD centres 2019-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	897	7	50	69	80	88	96	100
2022	837	27	50	69	81	89	96	100
2021	798	17	46	67	78	87	96	100
2020	764	21	47	68	80	89	98	100
2019	741	7	54	72	82	90	98	100

Figure 8.2.7(g): Variation in proportion of patients with URR ≥65% among HD centres 2023



SECTION 8.3: TECHNIQUE SURVIVAL ON DIALYSIS

There was no apparent difference in the unadjusted technique survival by years of starting dialysis for the years 2003 to 2022 even after censoring for death and transplant.

Table 8.3.1(a): Unadjusted technique survival by era, 2004-2023

Year Interval (month)	2004-2008			2009-2013			2014-2018			2019-2023		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	17042	100		27828	100		36842	100		42621	100	
6	15849	94	0	25682	93	0	34218	94	0	35648	94	0
12	14736	88	0	23860	87	0	31685	88	0	28794	88	0
24	12857	78	0	20686	77	0	27341	77	0	18233	76	0
36	11268	69	0	18022	68	0	23717	68	0	10409	66	0
48	9861	61	0	15602	59	0	20219	59	0	4518	58	0
60	8614	54	0	13463	52	0	17048	50	0	58	50	1
72	7518	47	0	11498	44	0	11382	42	0	1		
84	6435	41	0	9735	38	0	7069	35	0	1		
96	5545	35	0	8199	32	0	3826	30	0	1		
108	4825	31	0	6871	27	0	1549	25	0	1		
120	4178	27	0	5714	23	0	19	21	0	1		

Figure 8.3.1(a): Unadjusted technique survival by year of entry, 2004-2023

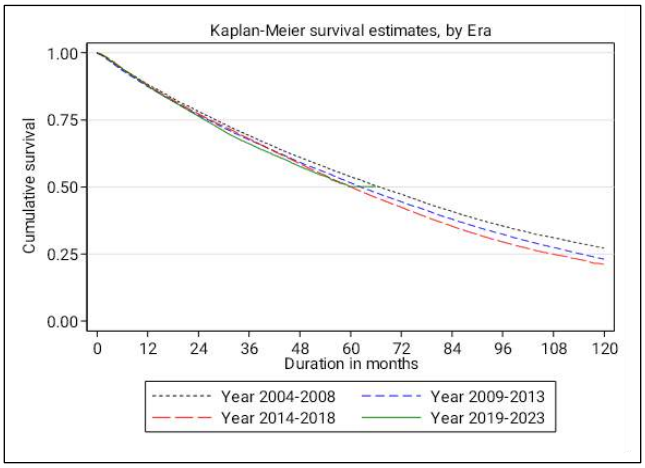


Figure 8.3.1(b): Unadjusted technique survival by year of entry (censored for death & transplant), 2004-2023

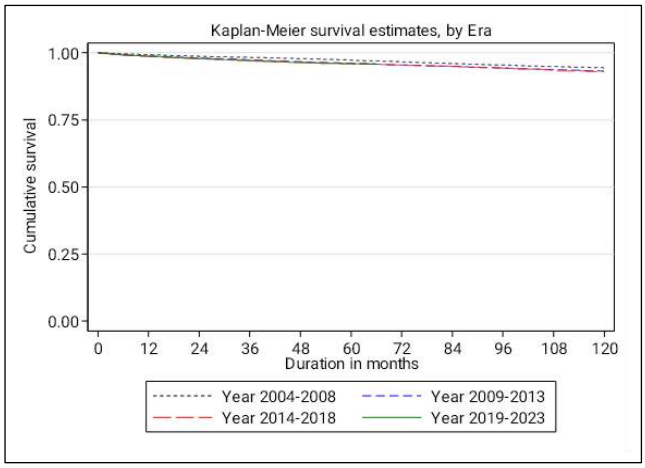


Table 8.3.1(b): Unadjusted technique survival by year of entry (censored for death & transplant), 2004-2023

Year Interval	2004-2008			2009-2013			2014-2018			2019-2023		
(month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	17042	100		27828	100		36842	100		42621	100	
6	15849	100	0	25682	99	0	34218	99	0	35648	99	0
12	14736	99	0	23860	99	0	31685	99	0	28794	99	0
24	12857	99	0	20686	98	0	27341	98	0	18233	98	0
36	11268	98	0	18022	97	0	23717	97	0	10409	97	0
48	9861	98	0	15602	97	0	20219	97	0	4518	96	0
60	8614	97	0	13463	96	0	17048	96	0	58	96	0
72	7518	97	0	11498	96	0	11382	95	0	1		
84	6435	96	0	9735	95	0	7069	95	0	1		
96	5545	96	0	8199	94	0	3826	94	0	1		
108	4825	95	0	6871	94	0	1549	93	0	1		
120	4178	94	0	5714	93	0	19	93	0	1		

There was no apparent difference in the unadjusted technique survival by age once censored for death & transplant except for those less than 15 years old. Patients who were less than 15 years old had poorer technique survival compared to all other age group. The 9 years unadjusted technique survival (censored for death & transplant) for the age groups of ≤14, 15-24, 25-34, 35-44, 44-54, 55-64 and ≥65 years old were 86%, 90%, 92%, 92%, 94%, 93% and 95% respectively.

Table 8.3.2(a): Unadjusted technique survival by age, 2014-2023

Age group (year)	≤ 14			15-24			25-34			35-44		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	220	100		1497	100		4646	100		9235	100	
6	188	96	1	1328	97	0	4001	97	0	7922	96	0
12	169	93	2	1184	93	1	3545	93	0	6954	92	0
24	139	86	3	983	89	1	2800	87	1	5400	84	0
36	117	78	3	818	86	1	2289	83	1	4197	77	1
48	98	72	4	682	83	1	1827	78	1	3202	72	1
60	71	63	4	546	79	1	1390	74	1	2277	65	1
72	52	62	4	419	77	1	1001	70	1	1602	59	1
84	36	57	4	302	74	2	715	65	1	1103	53	1
96	20	49	5	199	71	2	418	60	1	662	48	1
108	11	43	6	104	70	2	191	57	1	264	43	1
120	1			10	64	4	9	54	2	9	40	2

Age group (year)	45-54			55-64			≥ 65		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	17700	100		25301	100		23192	100	
6	15313	95	0	21751	94	0	19373	92	0
12	13397	89	0	18889	88	0	16343	84	0
24	10361	80	0	14338	76	0	11557	69	0
36	8084	71	0	10620	66	0	8004	57	0
48	6073	64	0	7595	57	0	5268	45	0
60	4375	56	0	5234	48	0	3217	34	0
72	3005	49	1	3421	39	0	1886	26	0
84	1910	41	1	1990	31	0	1016	19	0
96	1046	34	1	1038	25	0	487	14	0
108	434	29	1	396	20	1	156	10	0
120	19	25	1	6	17	1	9	7	1

Figure 8.3.2(a): Unadjusted technique survival by age, 2014-2023

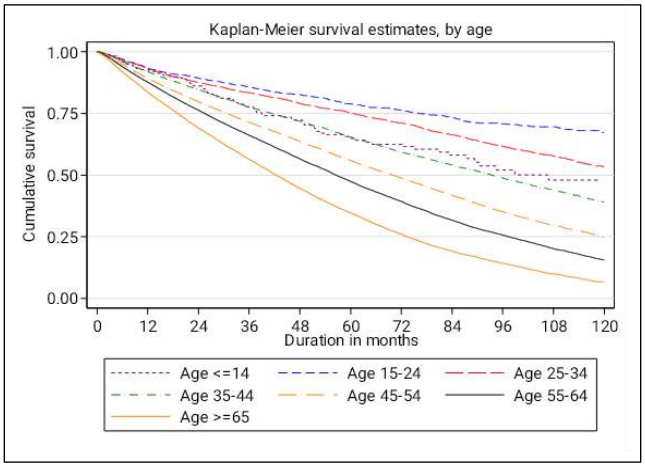


Figure 8.3.2(b): Unadjusted technique survival by age (censored for death & transplant), 2014-2023

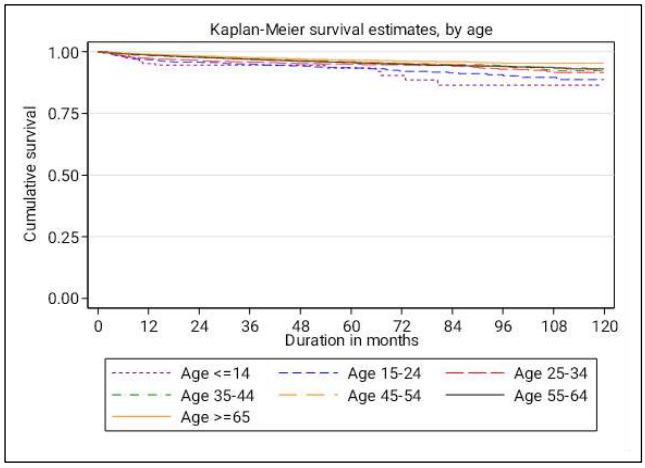


Table 8.3.2(b): Unadjusted technique survival by age (censored for death & transplant), 2014-2023

Age group (year)	≤ 14			15-24			25-34			35-44		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	220	100		1497	100		4646	100		9235	100	
6	188	98	1	1328	98	0	4001	98	0	7922	99	0
12	169	95	2	1184	97	0	3545	97	0	6954	99	0
24	139	95	2	983	96	1	2800	96	0	5400	98	0
36	117	95	2	818	95	1	2289	96	0	4197	97	0
48	98	95	2	682	94	1	1827	95	0	3202	96	0
60	71	93	2	546	94	1	1390	95	0	2277	96	0
72	52	90	3	419	92	1	1001	95	0	1602	95	0
84	36	86	4	302	91	1	715	94	0	1103	95	0
96	20	86	4	199	91	1	418	93	1	662	94	0
108	11	86	4	104	90	1	191	92	1	264	92	1
120	1			10	89	2	9	92	1	9	92	1

Age group (year)	45-54			55-64			≥ 65		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	17700	100		25301	100		23192	100	
6	15313	99	0	21751	99	0	19373	100	0
12	13397	99	0	18889	99	0	16343	99	0
24	10361	98	0	14338	98	0	11557	98	0
36	8084	97	0	10620	97	0	8004	98	0
48	6073	97	0	7595	96	0	5268	97	0
60	4375	96	0	5234	96	0	3217	97	0
72	3005	95	0	3421	95	0	1886	96	0
84	1910	95	0	1990	95	0	1016	96	0
96	1046	94	0	1038	94	0	487	96	0
108	434	94	0	396	93	0	156	95	0
120	19	93	1	6	93	1	9	95	0

Unadjusted technique survival in non-diabetics at 1, 5 and 10 years was 87%, 50% and 22% respectively. Unadjusted technique survival for diabetics was worse than non-diabetics; 89% at 1 year, 49% at 5 years and only 19% at 10 years. There was no apparent difference in the unadjusted technique survival by diabetes status when censored for death & transplant.

Table 8.3.3(a): Unadjusted technique survival by diabetes status, 2014-2023

Diabetes status	Non-Diabetic			Diabetic		
Interval (month)	n	% Survival	SE	n	% Survival	SE
0	59138	100		22653	100	
6	49843	94	0	20024	95	0
12	42766	87	0	17713	89	0
24	31886	77	0	13688	77	0
36	23616	67	0	10510	67	0
48	17281	58	0	7456	58	0
60	12155	50	0	4951	49	0
72	8098	42	0	3284	41	0
84	5102	36	0	1967	33	0
96	2826	30	0	1022	27	1
108	1171	26	0	378	22	1
120	14	22	1	18	19	1

Figure 8.3.3(a): Unadjusted technique survival by diabetes status, 2014-2023

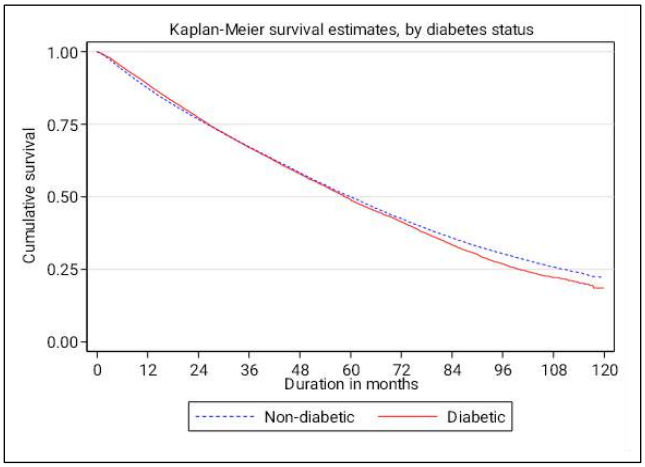


Figure 8.3.3(b): Unadjusted technique survival by diabetes status (censored for death & transplant), 2014-2023

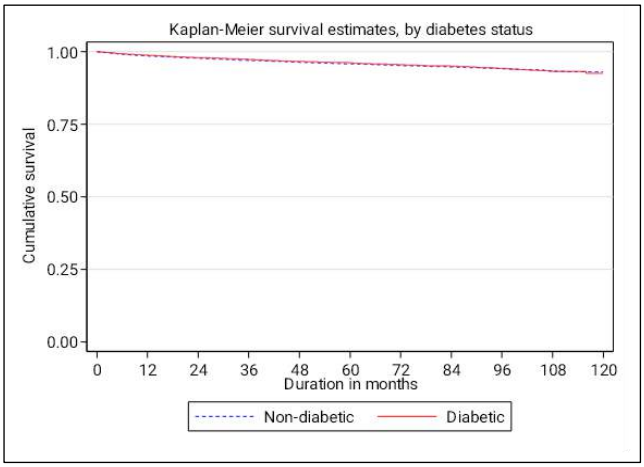


Table 8.3.3(b): Unadjusted technique survival by diabetes status (censored for death & transplant), 2014-2023

Diabetes status	Non-Diabetic			Diabetic		
Interval (month)	n	% Survival	SE	n	% Survival	SE
0	59138	100		22653	100	
6	49778	99	0	20089	99	0
12	42743	99	0	17736	99	0
24	31799	98	0	13775	98	0
36	23517	97	0	10609	97	0
48	17195	96	0	7542	97	0
60	12104	96	0	5002	96	0
72	8116	95	0	3266	96	0
84	5120	95	0	1949	95	0
96	2824	94	0	1015	94	0
108	1132	93	0	417	93	1
120	12	93	0	20	93	1

CHAPTER 9

PERITONEAL DIALYSIS

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SECTION 9.1: MODALITIES AND PRESCRIPTION OF PD

The prevalence of PD patients in 2023 was 8,430 which represents a growth of 6% from the previous year. CAPD is utilised for the majority of PD patients (77.6%) but there has been a steady increase in the proportion of APD to 16.5% of patients compared to 11-12% a decade ago. The proportion on DAPD remains stable at 5.1% (Table 9.1.1).

Since 2022, there have been changes in distribution between the three PD systems available in Malaysia. In 2023, the distribution was 48.4% on Baxter disconnect system, followed by 38.2% on Fresenius disconnect system and 13.3% on Lucenxia (Table 9.1.2). The distribution in APD disconnect systems are 70.9%, 19.4%, 9.7% among Baxter, Fresenius and Lucenxia respectively.

The majority of patients (82.6%) received standard prescriptions of 4 exchanges per day (Table 9.1.4a). However, there is an increased prescription of incremental dialysis of 3 exchanges per day or less over the last decade to 15.5% of patients in 2023. These figures naturally align with the dwell volumes being utilised. In those patients on CAPD, 80.5 % are using dwell volumes of 8L/day while 15.9% are using less 8L/day reflecting this practice of incremental PD. This trend is also seen in APD, with a 10% reduction in the proportion receiving a standard APD total dwell volume of 10L over the last decade (Table 9.1.4b).

The number of patients performing self-care, partially assisted and completely assisted CAPD in 2023 was 60.3%, 18% and 21.6% respectively. There was a reversed pattern in APD, where the majority in APD are 42.2% completely assisted, 19.4% partially assisted and 38.3% self-care (Table 9.1.5).

Table 9.1.1: Peritoneal dialysis regimes, 2014-2023

PD regime	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Standard CAPD	6545	77.6	6317	79.5	5785	78.4	5377	80.3	4924	80.8
DAPD	432	5.1	415	5.2	403	5.5	334	5	307	5
Automated PD/ CCPD	1393	16.5	1148	14.4	1132	15.3	902	13.5	756	12.4
Unknown / NA	60	0.7	67	0.8	57	0.8	81	1.2	107	1.8
Total	8430	100	7947	100	7377	100	6694	100	6094	100

PD regime	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Standard CAPD	4509	80.2	4183	78.8	3895	83.8	3604	83.6	3036	82
DAPD	279	5	195	3.7	126	2.7	157	3.6	161	4.3
Automated PD/ CCPD	648	11.5	593	11.2	566	12.2	520	12.1	470	12.7
Unknown / NA	186	3.3	335	6.3	61	1.3	29	0.7	35	0.9
Total	5622	100	5306	100	4648	100	4310	100	3702	100

Table 9.1.2: PD connectology, 2014-2023

PD connectology	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
CAPD	**6977**	**100**	**6732**	**100**	**6188**	**100**	**5711**	**100**	**5231**	**100**
Baxter	3376	48.4	3468	51.5	3286	53.1	3134	54.9	3008	57.5
Fresenius	2666	38.2	2781	41.3	2705	43.7	2416	42.3	2148	41.1
Lucenxia / Peritone	930	13.3	9	0.1	14	0.2	28	0.5	31	0.6
Others	2	0	0	0	0	0	0	0	0	0
Unknown / NA	3	0	474	7	183	3	133	2.3	44	0.8
APD	**1393**	**100**	**1148**	**100**	**1132**	**100**	**902**	**100**	**756**	**100**
Baxter	987	70.9	756	65.9	776	68.6	655	72.6	570	75.4
Fresenius	270	19.4	226	19.7	225	19.9	185	20.5	157	20.8
Lucenxia	135	9.7	139	12.1	107	9.5	46	5.1	24	3.2
Others	1	0.1	0	0	0	0	0	0	0	0
Unknown / NA	0	0	27	2.4	24	2.1	16	1.8	5	0.7

PD connectology	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
CAPD	**4788**	**100**	**4378**	**100**	**4021**	**100**	**3761**	**100**	**3197**	**100**
Baxter	2790	58.3	2482	56.7	2393	59.5	2471	65.7	2321	72.6
Fresenius	1980	41.4	1874	42.8	1613	40.1	1273	33.8	869	27.2
Lucenxia / Peritone	0	0	1	0	3	0.1	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0
Unknown / NA	18	0.4	21	0.5	12	0.3	17	0.5	7	0.2
APD	**648**	**100**	**593**	**100**	**566**	**100**	**520**	**100**	**470**	**100**
Baxter	478	73.8	413	69.6	409	72.3	394	75.8	385	81.9
Fresenius	145	22.4	136	22.9	125	22.1	106	20.4	81	17.2
Lucenxia	23	3.5	41	6.9	32	5.7	20	3.8	0	0
Others	0	0	0	0	0	0	0	0	0	0
Unknown / NA	2	0.3	3	0.5	0	0	0	0	4	0.9

Table 9.1.3: Number of patients on polymer glucose, Icodextrin, 2018-2023

	2023	2022	2021	2020	2019	2018
	n	n	n	n	n	n
Polymer glucose, Icodextrin	517	446	519	433	386	400

Table 9.1.4(a): CAPD Number of Exchanges per day, 2014-2023

Number of exchanges/ day	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
1	7	0.1	5	0.1	8	0.1	10	0.2	9	0.2
2	33	0.5	30	0.4	24	0.4	18	0.3	28	0.5
3	1040	14.9	834	12.4	595	9.6	455	8	430	8.2
4	5763	82.6	5724	85	5417	87.5	5076	88.9	4608	88.1
5	118	1.7	104	1.5	122	2	125	2.2	135	2.6
Unknown / NA	16	0.2	35	0.5	22	0.4	27	0.5	21	0.4
Total	6977	100	6732	100	6188	100	5711	100	5231	100

Number of exchanges/ day	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
1	6	0.1	5	0.1	6	0.1	5	0.1	5	0.1
2	19	0.4	14	0.3	9	0.2	8	0.2	9	0.2
3	365	7	246	5.1	173	3.8	162	3.8	149	4.1
4	4660	89.8	4432	92	4197	92.6	3947	93.4	3409	93.2
5	101	1.9	69	1.4	59	1.3	44	1	37	1
Unknown / NA	37	0.7	49	1	87	1.9	58	1.4	48	1.3
Total	5188	100	4815	100	4531	100	4224	100	3657	100

Table 9.1.4(b) (i): CAPD total dwell volumes per day, 2014-2023

Total dwell volumes /day	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Less than 8	1112	15.9	952	13.6	735	11.2	596	9.8	590	10.5
8	5617	80.5	5798	82.9	5596	85	5255	86.4	4808	85.8
10	217	3.1	207	3	214	3.3	192	3.2	170	3
12	9	0.1	9	0.1	9	0.1	7	0.1	7	0.1
Unknown / NA	22	0.3	32	0.5	27	0.4	30	0.5	26	0.5
Total	6977	100	6998	100	6581	100	6080	100	5601	100

Total dwell volumes /day	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Less than 8	378	8.2	279	6.6	169	4.5	155	4.5	187	6.5
8	3758	81.7	3579	84.8	3201	86.1	2957	86.1	2410	83.2
10	276	6	325	7.7	307	8.3	277	8.1	236	8.1
12	20	0.4	23	0.5	22	0.6	19	0.6	23	0.8
Unknown / NA	170	3.7	17	0.4	17	0.5	27	0.8	41	1.4
Total	4602	100	4223	100	3716	100	3435	100	2897	100

Table 9.1.4(b) (ii): APD total dwell volumes per day, 2014-2023

Total dwell volumes /day	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Less than 8	183	13.2	93	8.3	112	9.7	76	8.2	74	9.6
8	41	2.9	34	3	32	2.8	26	2.8	27	3.5
10	897	64.5	637	57	710	61.7	604	65.5	528	68.3
12	59	4.2	36	3.2	45	3.9	47	5.1	50	6.5
14	1	0.1	10	0.9	8	0.7	6	0.7	5	0.6
Unknown / NA	212	15.2	307	27.5	243	21.1	163	17.7	89	11.5
Total	1393	100.0	1117	100	1150	100	922	100	773	100

Total dwell volumes /day	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Less than 8	51	7.6	39	6.5	38	6.3	33	6	36	7
8	25	3.7	25	4.2	23	3.8	15	2.7	16	3.1
10	466	69.9	415	69.4	416	68.8	389	70.3	383	74.2
12	50	7.5	59	9.9	90	14.9	82	14.8	55	10.7
14	5	0.7	3	0.5	17	2.8	7	1.3	6	1.2
Unknown / NA	70	10.5	57	9.6	21	3.5	27	4.9	20	3.9
Total	667	100	598	100	605	100	553	100	516	100

Table 9.1.5: Assistance to Perform PD, 2014-2023

PD Regime / Assistant	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
CAPD	**6977**	**100**	**6732**	**100**	**6188**	**100**	**5711**	**100**	**5231**	**100**
Self-care	4210	60.3	3978	59.1	3673	59.4	3415	59.8	3232	61.8
Partial self-care	1256	18	1203	17.9	1093	17.7	950	16.6	806	15.4
Completely assisted	1508	21.6	1539	22.9	1412	22.8	1333	23.3	1174	22.4
Unknown / NA	3	0	12	0.2	10	0.2	13	0.2	19	0.4
Automated PD	**1393**	**100**	**1148**	**100**	**1132**	**100**	**902**	**100**	**756**	**100**
Self-care	534	38.3	432	37.6	430	38	338	37.5	270	35.7
Partial self-care	270	19.4	221	19.3	204	18	159	17.6	145	19.2
Completely assisted	588	42.2	494	43	497	43.9	404	44.8	339	44.8
Unknown / NA	1	0.1	1	0.1	1	0.1	1	0.1	2	0.3

PD Regime / Assistant	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
CAPD	**4788**	**100**	**4378**	**100**	**4021**	**100**	**3761**	**100**	**3197**	**100**
Self-care	2973	62.1	2666	60.9	2474	61.5	2367	62.9	2030	63.5
Partial self-care	720	15	649	14.8	650	16.2	604	16.1	405	12.7
Completely assisted	1074	22.4	1040	23.8	849	21.1	736	19.6	714	22.3
Unknown / NA	21	0.4	23	0.5	48	1.2	54	1.4	48	1.5
Automated PD	**648**	**100**	**593**	**100**	**566**	**100**	**520**	**100**	**470**	**100**
Self-care	220	34	194	32.7	183	32.3	166	31.9	155	33
Partial self-care	139	21.5	122	20.6	140	24.7	123	23.7	69	14.7
Completely assisted	287	44.3	275	46.4	228	40.3	224	43.1	236	50.2
Unknown / NA	2	0.3	2	0.3	15	2.7	7	1.3	10	2.1

Figure 9.1.5(a): Assistance to Perform CAPD, 2014-2023

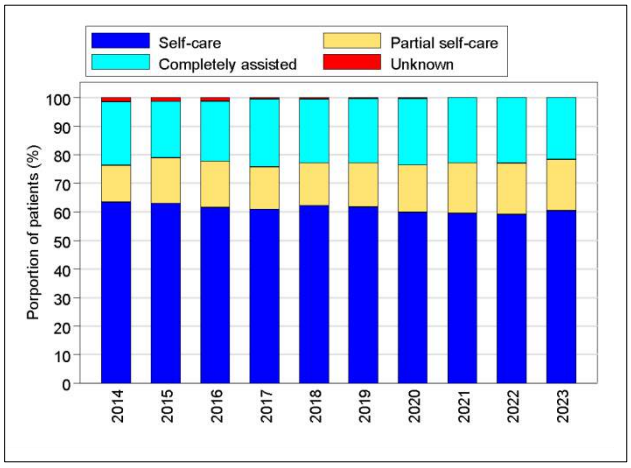
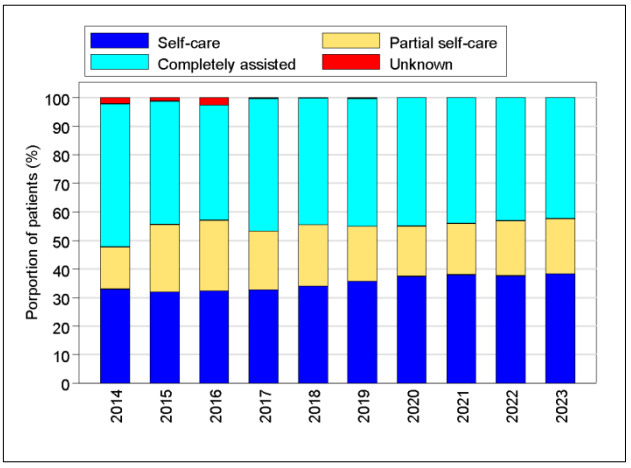


Figure 9.1.5(b): Assistance to Perform APD, 2014-2023



SECTION 9.2: ACHIEVEMENT OF SOLUTE CLEARANCE AND PERITONEAL TRANSPORT

Over the past ten years, the percentage of patients achieving the target delivered Kt/V of ≥ 1.7 has gradually declined. This decline is attributed to a shift in clinical practice priorities, moving away from a focus on Kt/V targets towards a more quality-oriented approach in peritoneal dialysis care.

There is a wide inter-centre variation in the proportion of patients achieving the delivered Kt/V in 2023. The percentage of patients achieving KT/V≥1.7 fluctuates between centres (Table and Figure 9.2.2). This variability may be due to differences in patient demographics, selection criteria, training or clinical practices at each centre.

Majority of incident PD patients exhibit low-average and high-average membrane transport status. This distribution proportion remains consistent across dialysis vintage, even after 10 years of therapy (Table 9.2.3).

Table 9.2.1: Distribution of delivered Kt/V, PD patients 2014-2023

Year	Number of Patients	Mean	SD	Median	LQ	UQ	% patients ≥ 1.7 per week
2023	6142	1.9	0.5	1.8	1.6	2.1	63
2022	5826	1.9	0.5	1.8	1.6	2.1	65
2021	5573	1.9	0.5	1.8	1.6	2.1	65
2020	5234	1.9	0.5	1.8	1.6	2.1	67
2019	4960	1.9	0.5	1.9	1.6	2.2	69
2018	4399	1.9	0.5	1.9	1.6	2.2	69
2017	4075	2	0.5	1.9	1.7	2.2	72
2016	3809	2	0.5	1.9	1.7	2.3	74
2015	3477	2	0.5	2	1.7	2.3	74
2014	3022	2	0.5	1.9	1.7	2.3	74

Table 9.2.2: Variation in proportion of patients with Kt/V ≥1.7 per week among PD centres, 2014-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	48	8	27	53.5	63	70.5	85	100
2022	47	30	33	56	65	78	86	91
2021	44	23	45	52.5	64	72	82	90
2020	42	22	50	55	65	75	82	92
2019	38	14	32	59	67	77	90	96
2018	35	20	31	59	68	78	90	95
2017	33	37	38	63	68	79	88	89
2016	32	50	54	63.5	74.5	82.5	89	92
2015	30	47	55	66	74.5	80	89	91
2014	28	44	47	66.5	73.5	80	89	89

Figure 9.2.2: Variation in proportion of patients with Kt/V ≥1.7 per week among PD centres 2014-2023

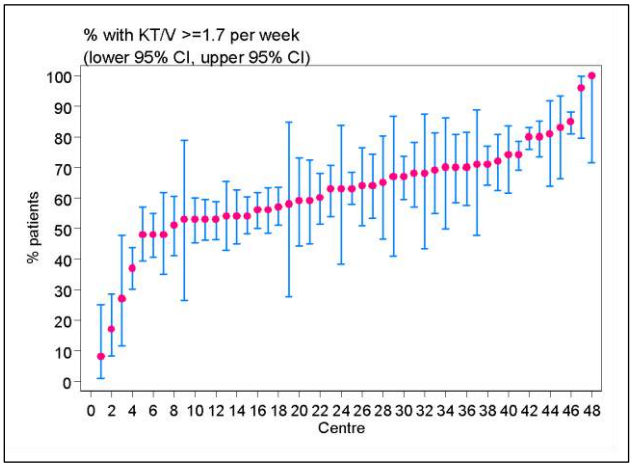


Table 9.2.3: Peritoneal transport status by PET D/P creatinine at 4 hours, incident PD patients 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Low	159	8.5	155	8.1	94	5.6	73	4.7	65	4.5
Low average	345	18.4	432	22.7	379	22.4	328	21	311	21.7
High average	326	17.4	525	27.6	528	31.2	530	33.9	543	37.9
High	129	6.9	254	13.3	241	14.2	237	15.2	260	18.1
Unknown / NA	918	48.9	539	28.3	450	26.6	396	25.3	255	17.8
Total	1877	100	1905	100	1692	100	1564	100	1434	100

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Low	40	3.2	45	4	40	4	40	3.5	35	3.5
Low average	257	20.9	288	25.4	240	23.8	243	21.4	235	23.6
High average	477	38.7	429	37.9	361	35.8	414	36.4	317	31.8
High	258	21	211	18.6	173	17.2	207	18.2	175	17.6
Unknown / NA	199	16.2	160	14.1	193	19.2	233	20.5	235	23.6
Total	1231	100	1133	100	1007	100	1137	100	997	100

Table 9.2.4: Peritoneal Transport Status (PET) in 2023 with dialysis vintage 0 to 10 years

Duration (year)	<1		1 - <2		2 - <3		3 - <4		4 - <5		5 - <6	
	n	%	n	%	n	%	n	%	n	%	n	%
Low	201	17.9	204	16.3	120	15.1	73	13.6	63	14.5	33	13.7
Low Average	391	34.8	440	35.1	288	36.3	182	33.9	163	37.6	98	40.7
High Average	380	33.8	444	35.4	289	36.4	220	41	147	33.9	88	36.5
High	151	13.4	167	13.3	97	12.2	62	11.5	61	14.1	22	9.13
Total	1123	100	1255	100	794	100	537	100	434	100	241	100

Duration (year)	6 - <7		7 - <8		8 - <9		9 - <10		10		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Low	18	12.9	17	17	17	17.5	10	20.4	0	0	756	15.8
Low Average	53	37.9	43	43	32	33	15	30.6	0	0	1705	35.7
High Average	54	38.6	32	32	33	34	20	40.8	0	0	1707	35.8
High	15	10.7	8	8	15	15.5	4	8.16	0	0	602	12.6
Total	140	100	100	100	97	100	49	100	0	0	4770	100

SECTION 9.3: TECHNIQUE SURVIVAL ON PD

Table and Figure 9.3.1(a) & (b) illustrates no difference in PD technique survival (uncensored or censored for death and transplant) between the different eras. After censoring for death and transplant, the technique survival in the latter era is lower than the former era.

Younger age had better technique survival compared to older age in uncensored for death and transplant (Table & Figure 9.3.2 (a)). However, this observation is reversed after censoring for death and transplant with increasing age having better technique survival (Table & Figure 9.3.2 (b)).

Female had better technique survival than male earlier on PD therapy till 12 months in uncensored for death and transplant. However, there was no difference between gender after 12 months in uncensored and censored for death and transplant (Table and Figure 6.3.3 (a) and (b)).

Diabetes had been associated with poor technique survival as early as 12 months on PD therapy in uncensored for death and transplant (Table & Figure 9.3.4(a)). After censoring for death and transplant, diabetic had worse technique survival initially but after 48 months of PD vintage, the trend changed with similar technique survival between diabetic and non-diabetic (Table & Figure 9.3.4(b)).

There was a consistent better technique survival with Kt/V >1.7 vs <1.7 and this observation occurred as early as 6 months. There was no difference in technique survival between Kt/V >1.7-2.0 or >2.0.

Technique survival was 86% at 1-year and 39% at 5-year in 2019-2023 when uncensored for death and transplant (Table 9.3.1(a). Technique survival after censoring for death and transplant was 91% and 58% at 1-year and 5-year respectively in 2019-2023.

Table 9.3.1(a): Unadjusted technique survival by era, 2004-2023 (uncensored for death and transplant)

Era	2004-2008			2009-2013			2014-2018			2019-2023		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	2413	100		4086	100		6954	100		10209	100	
6	2167	93	1	3643	93	0	6284	93	0	8273	94	0
12	1886	85	1	3220	86	1	5559	86	0	6270	86	0
24	1435	71	1	2449	72	1	4169	71	1	3326	72	1
36	1069	60	1	1836	59	1	3120	58	1	1581	59	1
48	799	49	1	1348	48	1	2258	46	1	593	49	1
60	589	40	1	999	39	1	1628	37	1	6	39	2
72	442	33	1	714	31	1	901	29	1	1		
84	330	27	1	534	26	1	501	23	1	1		
96	224	21	1	389	21	1	244	19	1	1		
108	174	18	1	316	19	1	83	15	1	1		
120	134	15	1	234	15	1	3	14	1	1		

Table 9.3.1(b): Unadjusted technique survival by era, 2004-2023 (censored for death and transplant)

Era Interval (month)	2004-2008 n	2004-2008 % Survival	2004-2008 SE	2009-2013 n	2009-2013 % Survival	2009-2013 SE	2014-2018 n	2014-2018 % Survival	2014-2018 SE	2019-2023 n	2019-2023 % Survival	2019-2023 SE
0	2413	100		4086	100		6954	100		10209	100	
6	2167	97	0	3643	97	0	6284	97	0	8273	96	0
12	1886	93	1	3220	92	0	5559	93	0	6270	91	0
24	1435	86	1	2449	84	1	4169	85	0	3326	82	0
36	1069	78	1	1836	77	1	3120	78	1	1581	73	1
48	799	71	1	1348	70	1	2258	72	1	593	65	1
60	589	65	1	999	65	1	1628	66	1	6	58	2
72	442	60	1	714	58	1	901	60	1	1		
84	330	55	2	534	52	1	501	54	1	1		
96	224	48	2	389	46	1	244	49	1	1		
108	174	43	2	316	43	1	83	44	2	1		
120	134	40	2	234	39	1	3	38	3	1		

Figure 9.3.1(a): Unadjusted technique survival by era, 2004-2023 (uncensored for death and transplant)

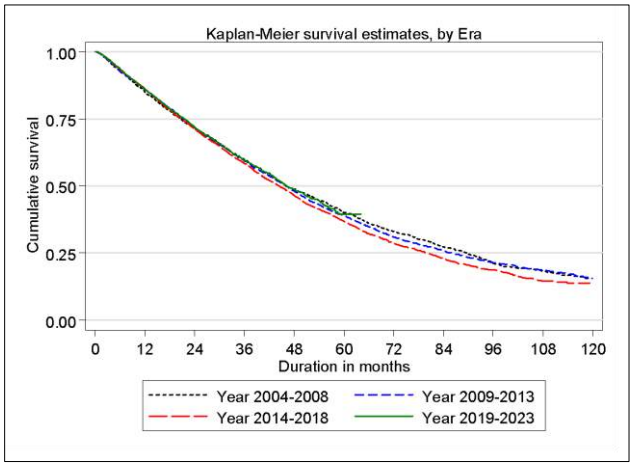


Figure 9.3.1(b): Unadjusted technique survival by era, 2004-2023 (censored for death and transplant)

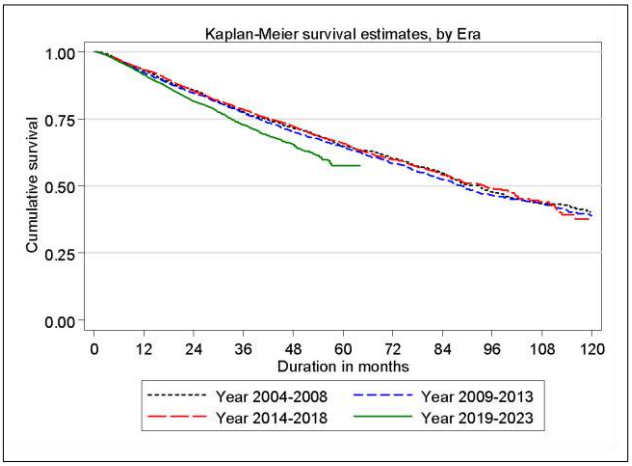


Table 9.3.2(a): Unadjusted technique survival by age (uncensored for death and transplant), 2014-2023

Age group (years)	20-24			25-34			35-44		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	414	100		1636	100		2284	100	
6	365	97	1	1430	97	0	1984	96	0
12	305	94	1	1213	94	1	1610	90	1
24	216	92	1	811	87	1	1051	80	1
36	153	87	2	553	82	1	670	71	1
48	100	83	3	357	75	2	428	62	1
60	66	77	3	226	68	2	253	52	2
72	42	70	4	140	61	2	143	42	2
84	25	66	5	89	57	3	70	34	2
96	19	60	6	38	51	3	34	29	3
108	8	60	6	13	43	5	15	22	3
120	1			2	39	6	2	22	3

Age group (years)	45-54			55-64			≥65		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	3497	100		4817	100		3673	100	
6	3014	95	0	4054	93	0	2977	89	1
12	2445	88	1	3284	84	1	2341	77	1
24	1557	74	1	2052	68	1	1345	57	1
36	1005	61	1	1195	52	1	778	41	1
48	629	50	1	686	39	1	409	27	1
60	375	41	1	361	28	1	203	17	1
72	209	32	1	174	19	1	98	11	1
84	124	25	1	93	14	1	50	7	1
96	62	21	2	42	10	1	20	4	1
108	26	17	2	11	7	1	3	1	1
120	1			1			1		

Table 9.3.2(b): Unadjusted technique survival by age (censored for death and transplant), 2014-2023

Age group (years)	20-24			25-34			35-44		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	414	100		1636	100		2284	100	
6	365	97	1	1430	96	0	1984	97	0
12	305	92	1	1213	91	1	1610	92	1
24	216	82	2	811	81	1	1051	82	1
36	153	73	3	553	72	1	670	74	1
48	100	64	3	357	64	2	428	64	1
60	66	60	3	226	55	2	253	57	2
72	42	54	4	140	48	2	143	52	2
84	25	51	4	89	42	2	70	46	2
96	19	51	4	38	36	3	34	43	3
108	8	42	6	13	32	3	15	38	4
120	1			2	27	5	2	35	5

Age group (years)	45-54			55-64			≥65		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	3497	100		4817	100		3673	100	
6	3014	97	0	4054	97	0	2977	97	0
12	2445	91	1	3284	93	0	2341	93	0
24	1557	82	1	2052	84	1	1345	86	1
36	1005	75	1	1195	76	1	778	81	1
48	629	69	1	686	71	1	409	77	1
60	375	63	1	361	66	1	203	72	2
72	209	58	2	174	60	2	98	68	2
84	124	52	2	93	56	2	50	65	3
96	62	48	2	42	50	3	20	59	4
108	26	47	3	11	45	4	3	40	11
120	1			1			1		

** Account for patients commenced dialysis from 2014-2023*

Figure 9.3.2(a): Unadjusted technique survival by age (uncensored for death and transplant), 2014-2023

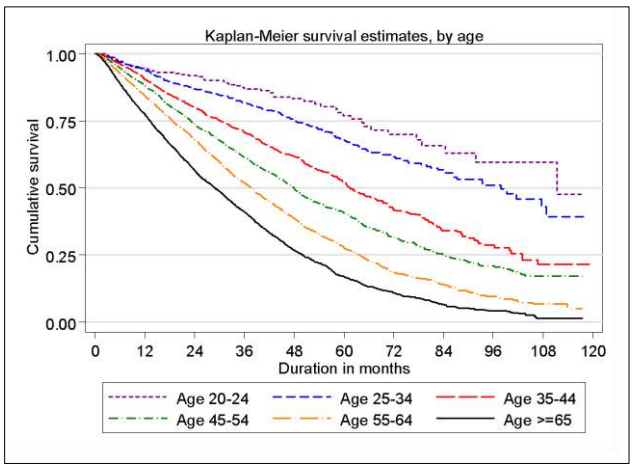


Figure 9.3.2(b): Unadjusted technique survival by age (censored for death and transplant), 2014-2023

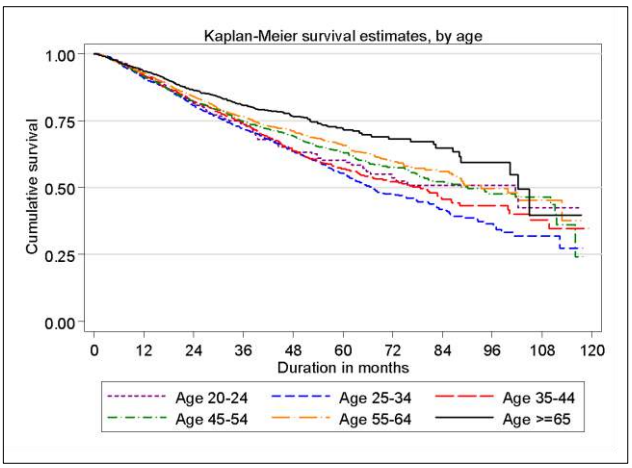


Table 9.3.3(a): Unadjusted technique survival by gender (uncensored for death and transplant), 2014-2023

Gender	Male			Female		
Interval (months)	n	% Survival	SE	n	% Survival	SE
0	9112	100		8051	100	
6	7765	94	0	6792	93	0
12	6248	86	0	5581	86	0
24	3884	71	1	3611	72	1
36	2384	57	1	2308	61	1
48	1349	44	1	1496	51	1
60	763	35	1	869	41	1
72	410	26	1	495	32	1
84	235	20	1	267	27	1
96	113	16	1	132	23	1
108	37	12	1	46	18	1
120	2	11	1	2	17	1

Table 9.3.3(b): Unadjusted technique survival by gender (censored for death and transplant), 2014-2023

Gender	Male			Female		
Interval (months)	n	% Survival	SE	n	% Survival	SE
0	9112	100		8051	100	
6	7765	97	0	6792	97	0
12	6248	92	0	5581	93	0
24	3884	83	0	3611	84	0
36	2384	75	1	2308	76	1
48	1349	68	1	1496	71	1
60	763	62	1	869	64	1
72	410	56	1	495	58	1
84	235	52	1	267	52	1
96	113	47	2	132	47	2
108	37	43	2	46	42	2
120	2	34	4	2	37	3

Figure 9.3.3(a): Unadjusted technique survival by gender (uncensored for death and transplant), 2014-2023

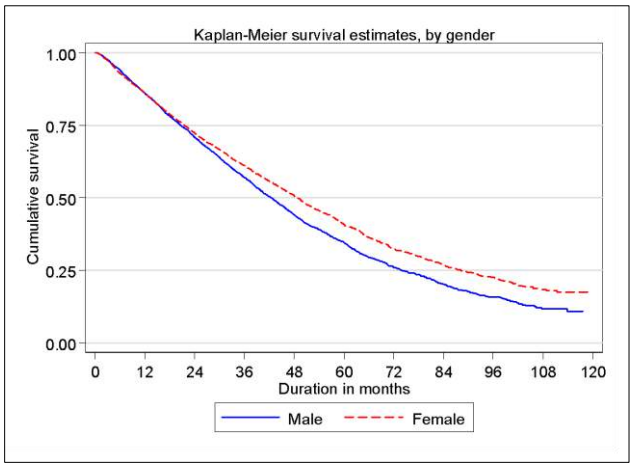


Figure 9.3.3(b): Unadjusted technique survival by gender (censored for death and transplant), 2014-2023

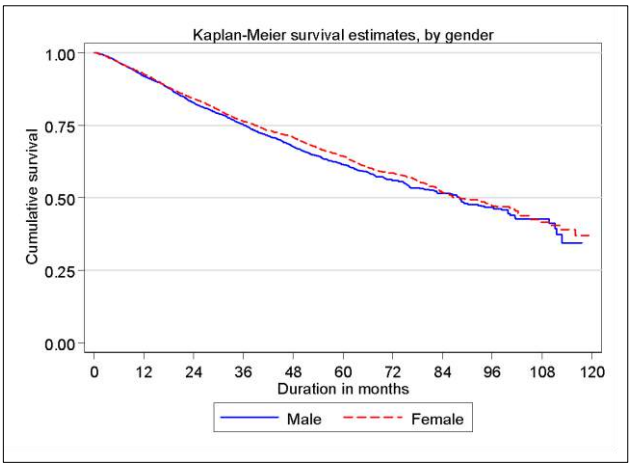


Table 9.3.4(a): Unadjusted technique survival by diabetes status (uncensored for death and transplant), 2014-2023

Diabetes status	Non-diabetic			Diabetic		
Interval (months)	n	% Survival	SE	n	% Survival	SE
0	20648	100		6356	100	
6	11575	94	0	2908	93	0
12	9321	86	0	2444	86	1
24	5848	72	0	1613	70	1
36	3622	60	1	1050	56	1
48	2228	49	1	600	42	1
60	1318	39	1	305	32	1
72	743	31	1	152	22	1
84	429	26	1	68	15	1
96	213	21	1	29	11	1
108	74	17	1	8	7	2
120	3	16	1	1		

Table 9.3.4(b): Unadjusted technique survival by diabetes status (censored for death and transplant), 2014-2023

Diabetes status	Non-diabetic			Diabetic		
Interval (months)	n	% Survival	SE	n	% Survival	SE
0	20648	100		6356	100	
6	11580	97	0	2904	96	0
12	9325	93	0	2445	90	1
24	5859	85	0	1605	80	1
36	3635	77	0	1039	73	1
48	2236	70	1	594	68	1
60	1330	64	1	296	62	1
72	749	58	1	148	56	2
84	429	52	1	69	52	2
96	207	47	1	34	46	3
108	71	42	2	11	39	4
120	2	37	3	2	32	8

Figure 9.3.4(a): Unadjusted technique survival by Diabetes status (uncensored for death and transplant), 2014-2023

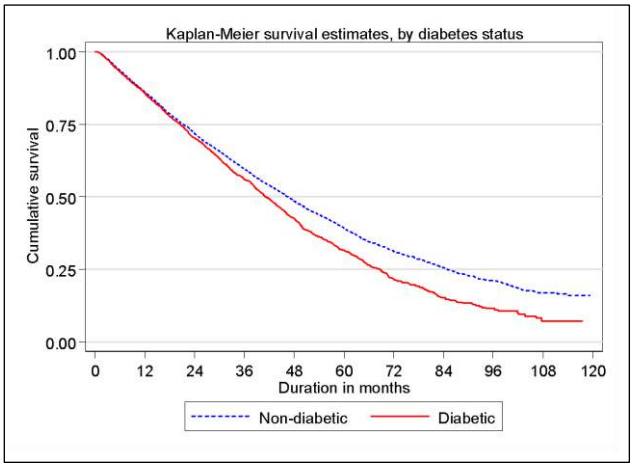


Figure 9.3.4(b): Unadjusted technique survival by diabetes status (censored for death and transplant), 2014-2023

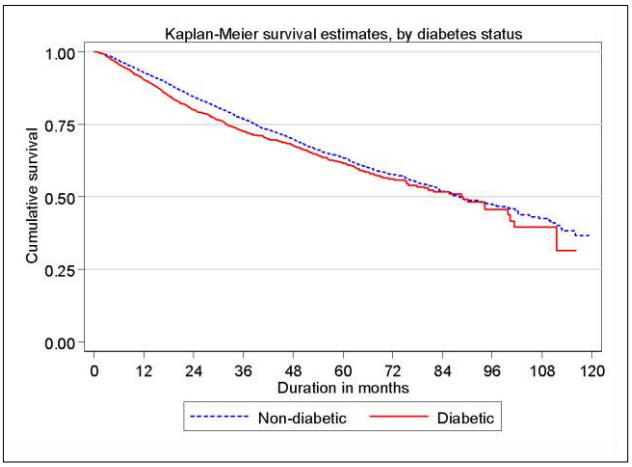
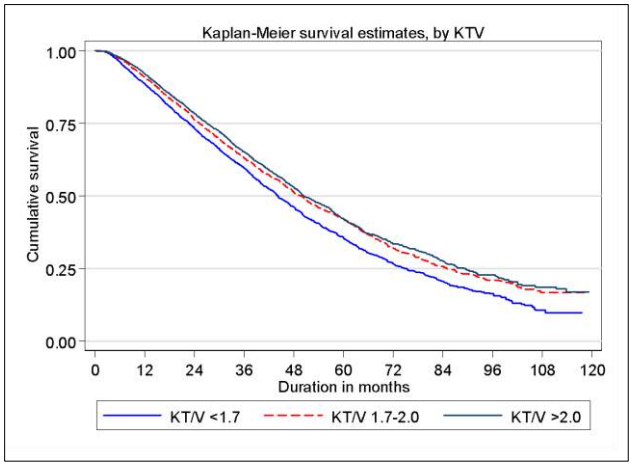


Table 9.3.5: Unadjusted technique survival by Kt/V, 2014-2023

Kt/V	<1.7			1.7-2.0			>2.0		
Interval (month)	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	4882	100		4010	100		4989	100	
6	4507	96	0	3724	97	0	4675	98	0
12	3743	89	0	3160	91	0	3971	92	0
24	2383	73	1	2108	76	1	2627	79	1
36	1461	60	1	1373	63	1	1688	65	1
48	834	46	1	859	51	1	1073	53	1
60	442	36	1	533	42	1	614	42	1
72	236	27	1	290	32	1	352	33	1
84	127	20	1	160	26	1	198	28	1
96	55	16	1	86	21	1	96	23	1
108	19	10	2	30	17	2	32	19	1
120	2	10	2	2	17	2	1		

Figure 9.3.5: Unadjusted technique survival by Kt/V, 2014-2023



In 2023, the main cause for PD drop-out was death (49.4%), followed by PD infections (23.4%) (Table 9.3.6), The PD drop out occurring < 3 months on PD therapy was lower (4.3%) as compared to previous year. Meanwhile, PD drop out at 3-12 months was 22.2% and 73.3% after 12 months (Table 9.3.8).

Table 9.3.6: Reasons for drop-out from PD program, 2014-2023

Year	2023		2022		2021		2020		2019	
Reasons	n	%	n	%	n	%	n	%	n	%
Death	1108	49.4	1184	65.6	1169	72	882	66.2	893	68.7
Transplant	43	1.9	32	1.8	8	0.5	27	2	27	2.1
PD infections	524	23.4	305	16.9	223	13.7	179	13.4	165	12.7
Inadequate dialysis	100	4.5	29	1.6	33	2	37	2.8	49	3.8
Catheter related issues	254	11.3	132	7.3	94	5.8	97	7.3	79	6.1
Social reasons	167	7.4	96	5.3	73	4.5	74	5.6	53	4.1
Others	42	1.9	25	1.4	20	1.2	36	2.7	21	1.6
Unknown	4	0.2	2	0.1	3	0.2	1	0.1	13	1
Total	2242	100	1805	100	1623	100	1333	100	1300	100
Patient at risk	8430		7947		7377		6694		6094	

Year	2018		2017		2016		2015		2014	
Reasons	n	%	n	%	n	%	n	%	n	%
Death	819	69.9	775	73.3	731	67.3	631	65.4	576	70.2
Transplant	25	2.1	8	0.8	6	0.6	10	1	14	1.7
PD infections	144	12.3	118	11.2	127	11.7	122	12.6	67	8.2
Inadequate dialysis	34	2.9	33	3.1	55	5.1	38	3.9	34	4.1
Catheter related issues	68	5.8	30	2.8	51	4.7	35	3.6	35	4.3
Social reasons	50	4.3	35	3.3	53	4.9	55	5.7	45	5.5
Others	23	2	18	1.7	17	1.6	11	1.1	7	0.9
Unknown	8	0.7	41	3.9	46	4.2	63	6.5	42	5.1
Total	1171	100	1058	100	1086	100	965	100	820	100
Patient at risk	5622		5306		4648		4310		3702	

Figure 9.3.6: Reasons for drop-out from PD program, 2014-2023

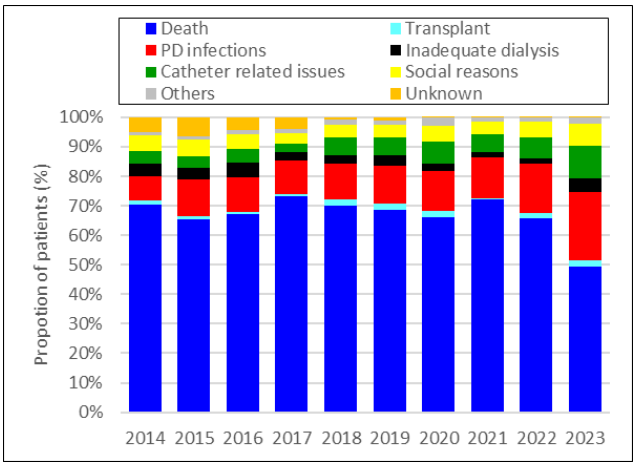


Table 9.3.7: Drop-out rate from PD program with time on treatment, 2014-2023

Year	2023		2022		2021		2020		2019	
Time	n	%	n	%	n	%	n	%	n	%
< 3 months	100	4.5	92	5.1	81	5	69	5.2	54	4.2
3-<6 months	178	7.9	125	6.9	112	6.9	93	7	82	6.3
6- <12 months	320	14.3	261	14.5	208	12.8	212	15.9	173	13.3
≥12 months	1644	73.3	1327	73.5	1222	75.3	959	71.9	991	76.2
Total	2242	100	1805	100	1623	100	1333	100	1300	100

Year	2018		2017		2016		2015		2014	
Time	n	%	n	%	n	%	n	%	n	%
< 3 months	41	3.5	46	4.3	40	3.7	63	6.5	45	5.5
3-<6 months	80	6.8	75	7.1	87	8	90	9.3	79	9.6
6- <12 months	151	12.9	122	11.5	146	13.4	138	14.3	99	12.1
≥12 months	899	76.8	815	77	813	74.9	674	69.8	597	72.8
Total	1171	100	1058	100	1086	100	965	100	820	100

SECTION 9.4: PERITONITIS

The median peritonitis rate in 2023 is 0.32 episodes/patient-year (1 in 37.5 patient-months). There is still significant inter-centre variation as illustrated in Table and Figure 9.4.1, the highest peritonitis rate is 1.0 episodes/patient- year (1:12 patient-months) and the lowest at 0 episodes/patient-year. The contribution of gram positive and gram-negative organisms to peritonitis is 33.6% and 29.5% respectively, while fungal and mycobacterial infections account for 4.1% and 2.2% respectively (Table 9.4.2). Culture-negative peritonitis rates remain high at 25.9% of all episodes in 2023, and it is worsening as compared to previous years. In terms of overall outcomes, 63.5% of peritonitis episodes resolved, with 26.9% resulting in catheter loss either due to relapse or unresolved peritonitis (Table 9.4.3).

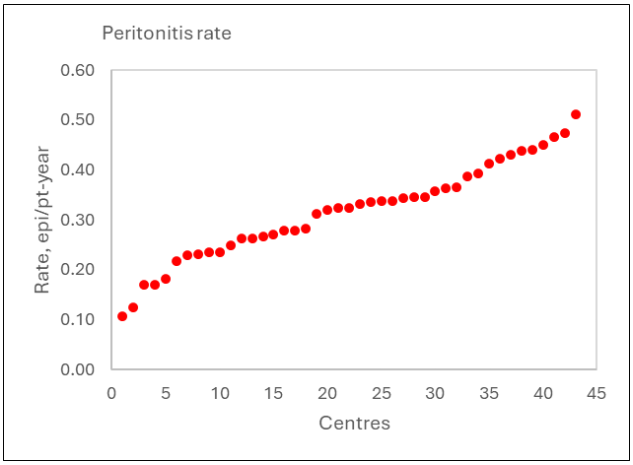
The mortality rate in 2023 was 9.5% of all episodes, and the pattern of the causative organisms remained the same; highest mortality was seen in infections due to mycobacteria, E. Coli and fungus (Table 9.4.4).

Multivariate analysis indicates that age above 55 years and requirement for assistance with PD are risk factors associated with peritonitis (Table 9.4.5).

Table 9.4.1: Variation of peritonitis rate (epi/pt-year) among PD centres, 2018-2023

Year	Number of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2023	60	0.00	0.00	0.21	0.32	0.40	0.59	1.00
2022	58	0.05	0.05	0.25	0.30	0.40	0.55	0.55
2021	54	0.00	0.05	0.19	0.25	0.33	0.52	0.74
2020	50	0.00	0.03	0.23	0.28	0.42	0.60	0.64
2019	46	0.08	0.08	0.19	0.28	0.41	0.67	0.67
2018	45	0.00	0.06	0.22	0.28	0.37	1.01	1.37

Figure 9.4.1: Variation in peritonitis rate among PD centres, 2023



**Excluded 17 centres with less than 30 patients*

Table 9.4.2: Causative organism in PD peritonitis, 2018-2023

	2023		2022		2021		2020		2019		2018	
	n	%	n	%	n	%	n	%	n	%	n	%
(A) Gram Positives												
Staph aureus	212	10.3	190	10.7	154	9.9	153	10.5	152	12.6	142	11.3
Staph coagulase negative	137	6.6	105	5.9	86	5.5	96	6.6	128	10.6	116	9.2
Streptococcus	145	7.0	90	5.0	107	6.9	112	7.7	74	6.1	78	6.2
Others	201	9.7	223	12.5	225	14.5	165	11.3	50	4.1	72	5.7
(B) Gram Negatives												
Pseudomonas	220	10.7	177	9.9	130	8.4	130	8.9	87	7.2	86	6.8
Acinetobacter	40	1.9	34	1.9	34	2.2	24	1.6	27	2.2	26	2.1
Klebsiella	100	4.8	83	4.7	83	5.3	80	5.5	56	4.6	77	6.1
Enterobacter	38	1.8	33	1.9	27	1.7	28	1.9	12	1.0	26	2.1
E. Coli	113	5.5	104	5.8	79	5.1	84	5.7	79	6.6	78	6.2
Others	100	4.8	89	5.0	70	4.5	63	4.3	52	4.3	51	4.1
(C) Polymicrobial	12	0.6	12	0.7	16	1.0	14	1.0	10	0.8	12	1.0
(D) Others												
Fungus	84	4.1	77	4.3	68	4.4	53	3.6	53	4.4	50	4.0
Mycobacterium	46	2.2	33	1.9	25	1.6	29	2.0	23	1.9	13	1.0
Others	70	3.4	92	5.2	61	3.9	47	3.2	29	2.4	41	3.3
(E) No growth	535	25.9	404	22.7	366	23.5	372	25.5	353	29.3	366	29.1
(F) Unknown	10	0.5	37	2.1	24	1.5	11	0.8	21	1.7	24	1.9
Total	2063	100	1783	100	1555	100	1461	100	1206	100	1258	100

Figure 9.4.2: Causative organism in PD peritonitis, 2018-2023

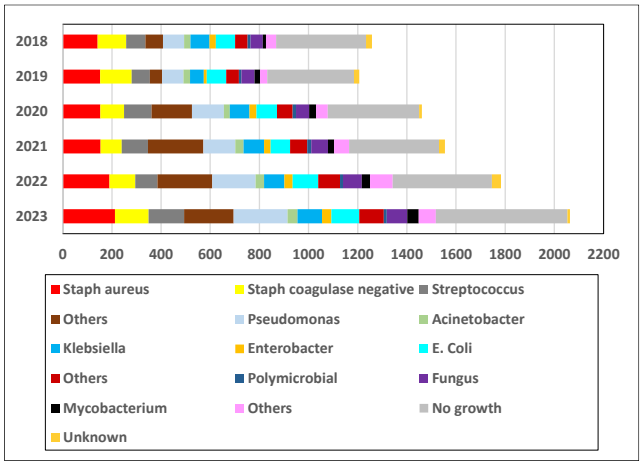


Table 9.4.3: Overall outcomes of PD peritonitis, 2018-2023

Year	Resolved		Relapsed Then Resolved		Relapsed Catheter Removed		Not Resolved Catheter Removed		Death		Unknown		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
2023	1280	62.0	31	1.5	70	3.4	485	23.5	197	9.5	0	0.0	2063	100
2022	1094	61.4	46	2.6	59	3.3	458	25.7	102	5.7	24	1.3	1783	100
2021	1010	65.0	27	1.7	39	2.5	368	23.7	81	5.2	30	1.9	1555	100
2020	968	66.3	38	2.6	37	2.5	337	23.1	54	3.7	27	1.8	1461	100
2019	775	64.3	29	2.4	22	1.8	280	23.2	68	5.6	32	2.7	1206	100
2018	819	65.1	32	2.5	40	3.2	280	22.3	67	5.3	20	1.6	1258	100

Table 9.4.4: Outcome of peritonitis by causative organism, 2018-2023

	Outcome									
	Resolved		Catheter removed		Death		Unknown		Total	
	n	%	n	%	n	%	n	%	n	%
(A) Gram Positives	2537	79.0	533	16.6	97	3.0	46	1.4	3213	100
Staph aureus	747	74.5	204	20.3	39	3.9	13	1.3	1003	100
Staph coagulase negative	566	84.7	79	11.8	12	1.8	11	1.6	668	100
Streptococcus	527	87.0	62	10.2	9	1.5	8	1.3	606	100
Others	697	74.5	188	20.1	37	4.0	14	1.5	936	100
(B) Gram Negatives	1627	62.1	792	30.2	154	5.9	47	1.8	2620	100
Pseudomonas	420	50.6	360	43.4	39	4.7	11	1.3	830	100
Acinetobacter	119	64.3	55	29.7	10	5.4	1	0.5	185	100
Klebsiella	325	67.8	109	22.8	31	6.5	14	2.9	479	100
Enterobacter	119	72.6	37	22.6	4	2.4	4	2.4	164	100
E. Coli	358	66.7	112	20.9	54	10.1	13	2.4	537	100
Others	286	67.3	119	28.0	16	3.8	4	0.9	425	100
(C) Polymicrobial	51	67.1	21	27.6	4	5.3	0	0.0	76	100
(D) Others	238	26.6	564	63.1	73	8.2	19	2.1	894	100
Fungus	24	6.2	323	83.9	31	8.1	7	1.8	385	100
Mycobacterium	19	11.2	119	70.4	24	14.2	7	4.1	169	100
Others	195	57.4	122	35.9	18	5.3	5	1.5	340	100
(E) No growth	1696	70.8	561	23.4	122	5.1	17	0.7	2396	100
(F) Unknown	0	0.0	4	3.1	119	93.7	4	3.1	127	100

Figure 9.4.4: Outcome of peritonitis by causative organism, 2018-2023

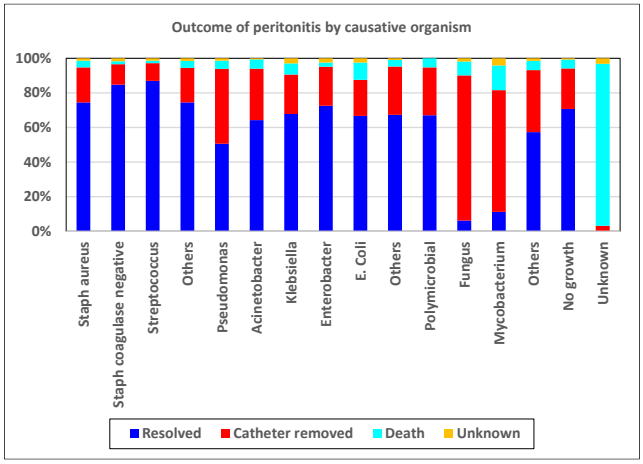


Table 9.4.5: Risk factors influencing peritonitis rate, 2014-2023

Factors	n	Risk Ratio	95% CI	P value
Age (years)				
20-24	148	1.02	(0.88, 1.18)	0.828
25-34 (ref*)	443	1		
35-44	678	1.05	(0.95, 1.16)	0.347
45-54	1015	1.05	(0.96, 1.15)	0.306
55-64	1401	1.13	(1.03, 1.24)	0.01
>=65	971	1.17	(1.06, 1.29)	0.002
Gender				
Male (ref*)	2938	1		
Female	2669	0.99	(0.95, 1.04)	0.733
Diabetes				
No (ref*)	3830	1		
Yes	1017	1.03	(0.98, 1.09)	0.226
Income				
<RM 1000 (ref*)	1466	1		
RM 1000-3000	2396	0.96	(0.91, 1.01)	0.106
RM 3001-5000	683	0.93	(0.86, 1.01)	0.07
RM 5001-10000	251	0.99	(0.88, 1.12)	0.903
>=RM 10000	51	1.29	(1.04, 1.6)	0.022
Education				
Nil	224	0.98	(0.88, 1.1)	0.768
Primary	1196	0.99	(0.94, 1.05)	0.78
Secondary (ref*)	2600	1		
Tertiary	827	1.02	(0.95, 1.1)	0.542
Assistance to perform CAPD				
Self-care (ref*)	2415	1		
Partially assisted	922	1.16	(1.09, 1.24)	<0.001
Completely assisted	1510	1.24	(1.17, 1.31)	<0.001

CHAPTER 10

RENAL TRANSPLANTATION

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SECTION 10.1: STOCK AND FLOW

In 2023, renal transplantation showed significant positive momentum, with the number of new transplant patients reaching 279. This reflects a sustained recovery from the previous disruptions caused by the COVID-19 pandemic, which had reduced new transplants to just 80 in 2021 and 213 in 2022 (Table 10.1.1). The steady increase in numbers highlights the resumption of elective surgeries and organ transplant programs. The increase in number was driven mainly by deceased donor program where the number increased from 43 in 2022 to 81 in 2023 (88.4% increase). There was slight increase in the number of local living donor transplants from 140 in 2022 to 168 in 2023 (20% increase). The number of overseas transplant remain relatively static. (Table 10.1.4). Local transplant centres, particularly Hospital Kuala Lumpur, have been instrumental in recovering transplant numbers, performing 110 transplants in 2023, an increase from 92 in 2022 (Table 10.1.4).

The total number of functioning allografts was recorded at 2,101 at the end of 2023, marking a 10.4% growth from 2022's figure of 1,923. This improvement not only signals an increase in the volume of transplants but also indicates improvement in donor management and post-transplant care, which are crucial for patient outcomes (Table 10.1.1).

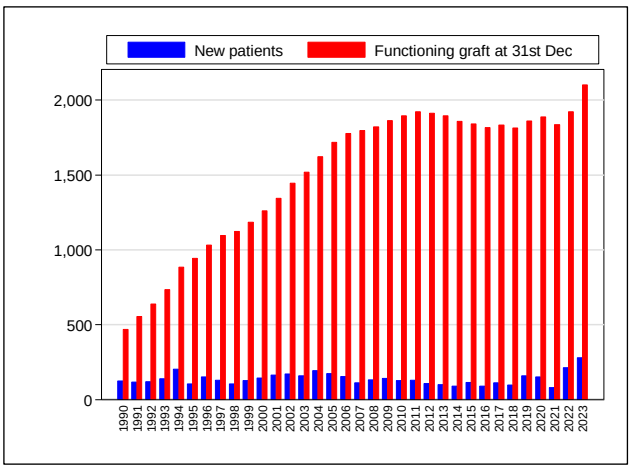
Mortality among transplant patients have decreased, dropping to 40 in 2023 from 74 in 2022 and 89 in 2021. The reduction in the number of deaths suggests better patient selection, pre-transplant evaluation and preparation, as well as post operative care (Table 10.1.1).

Allograft failures similarly decreased, from 37 in 2022 to 21 in 2023, underscoring improvements in clinical strategies and patient care (Table 10.1.1).

Table 10.1.1: Stock and flow of renal transplantation, 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New transplant patients	279	213	80	152	160	98	112	91	115	91
Died	40	74	89	58	53	45	49	49	64	65
Graft failure	21	37	36	41	37	47	28	49	52	41
Lost to Follow up	7	10	7	17	22	18	9	11	8	18
Functioning graft at 31st December	**2101**	**1923**	**1835**	**1889**	**1861**	**1813**	**1834**	**1816**	**1842**	**1858**

Figure 10.1.1: Stock and flow of renal transplantation, 1990-2023



The new transplant rate per million population (pmp) reached 8 in 2023, up from 7 in 2022, the highest rate in the last three decades (Table 10.1.2). The transplant prevalence rate also rose to 63 pmp, indicating a growing number of patients living with functioning allografts (Table 10.1.3).

Table 10.1.2: New transplant rate per million population (pmp), 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New transplant patients	279	213	80	152	160	98	112	91	115	91
New transplant rate, pmp	8	7	2	5	5	3	4	3	4	3

Figure 10.1.2: New transplant rate, 1990-2023

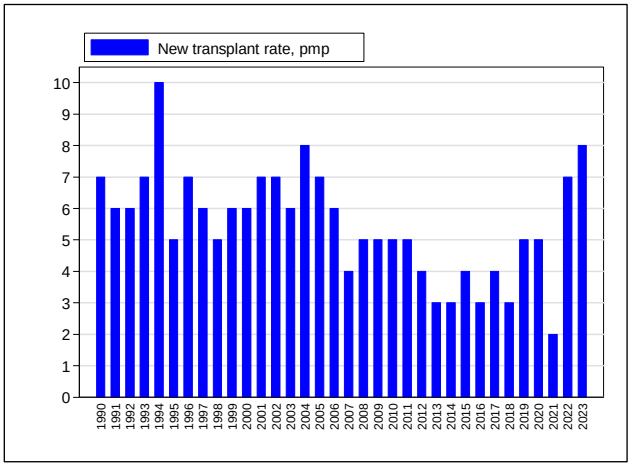


Figure 10.1.3: Transplant prevalence rate, 1990-2023

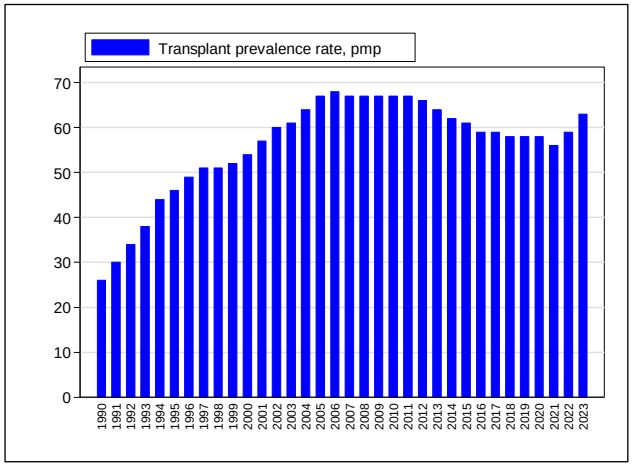


Table 10.1.3: Transplant prevalence rate per million population (pmp), 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Functioning graft at 31stDecember	2101	1923	1835	1889	1861	1813	1834	1816	1842	1858
Transplant prevalence rate, pmp	63	59	56	58	58	58	59	59	61	62

Despite these positive developments, the data indicate an alarming trend in overseas transplants, with the most significant number occurring in Cambodia, where 23 transplants were reported, constituting 8.2% of total overseas transplants in 2023 (Table 10.1.4). This trend raises ethical concerns regarding commercial transplant practices, which can negatively affect patient safety and the integrity of the transplantation system.

In conclusion, 2023 presents a hopeful landscape for kidney transplantation in Malaysia. However, much work and support especially from the Ministry of Health, collaboration with private health care is required to sustain these numbers and outcome. The rise in overseas transplants necessitates immediate attention. In order to preserve the integrity of kidney transplantation in the country.

Figure 10.1.4(a): Places of transplantation, 1990-2023

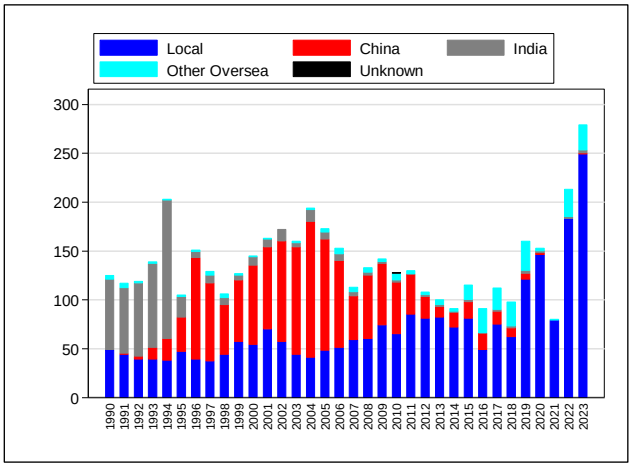


Figure 10.1.4(b): Place of transplantation within Malaysia, 1990-2023

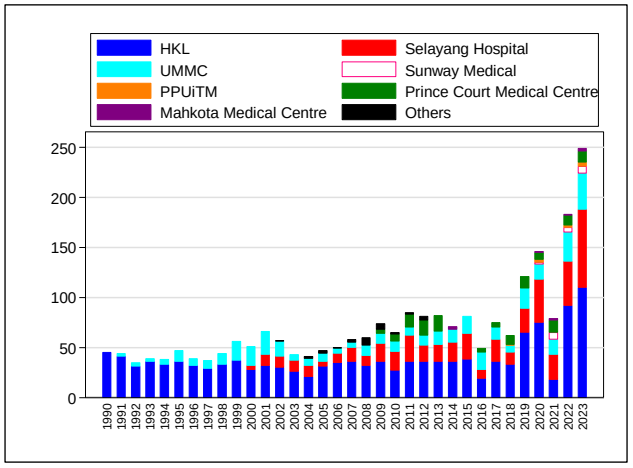


Table 10.1.4 (a): Place of local transplantation, 2014-2023

	2023		2022		2021		2020		2019		2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
	Deceased Donor Kidney Transplant																			
HKL	35	12.5	21	9.9	1	1.3	17	11.2	14	8.8	6	6.1	10	8.9	4	4.4	27	23.5	19	21.1
Selayang	44	15.8	22	10.3	13	16.3	20	13.2	15	9.4	4	4.1	15	13.4	4	4.4	23	20	18	20
UMMC	2	0.7	0	0	1	1.3	3	2	1	0.6	1	1	1	0.9	1	1.1	1	0.9	2	2.2
Total Deceased Donor	81	29	43	20.2	15	18.9	40	26.4	30	18.8	11	11.2	26	23.2	9	9.9	51	44.4	39	43.3
	Living Donor Kidney Transplant																			
HKL	75	26.9	71	33.3	17	21.3	58	38.2	51	31.9	27	27.6	26	23.2	15	16.5	11	9.6	17	18.9
Selayang	34	12.2	22	10.3	12	15	23	15.1	9	5.6	8	8.2	7	6.3	5	5.5	3	2.6	1	1.1
UMMC	34	12.2	29	13.6	14	17.5	12	7.9	19	11.9	6	6.1	11	9.8	16	17.6	16	13.9	11	12.2
Prince Court Medical Centre	11	3.9	10	4.7	12	15	7	4.6	12	7.5	9	9.2	5	4.5	4	4.4	0	0	0	0
Sunway Medical	7	2.5	5	2.3	7	8.8	2	1.3	0	0	0	0	0	0	0	0	0	0	0	0
PPUiTM	4	1.4	2	0.9	0	0	3	2	0	0	1	1	0	0	0	0	0	0	0	0
Mahkota Medical Centre	3	1.1	1	0.5	2	2.5	1	0.7	0	0	0	0	0	0	0	0	0	0	3	3.3
Total Living Donor	168	60.2	140	65.6	64	80.1	106	69.8	91	56.9	51	52.1	49	43.8	40	44	30	26.1	32	35.5
	Local Transplant																			
HKL	110	39.4	92	43.2	18	22.6	75	49.4	65	40.7	33	33.7	36	32.1	19	20.9	38	33.1	36	40
Selayang	78	28	44	20.6	25	31.3	43	28.3	24	15	12	12.3	22	19.7	9	9.9	26	22.6	19	21.1
UMMC	36	12.9	29	13.6	15	18.8	15	9.9	20	12.5	7	7.1	12	10.7	17	18.7	17	14.8	13	14.4
Prince Court Medical Centre	11	3.9	10	4.7	12	15	7	4.6	12	7.5	9	9.2	5	4.5	4	4.4	0	0	0	0
Sunway Medical	7	2.5	5	2.3	7	8.8	2	1.3	0	0	0	0	0	0	0	0	0	0	0	0
PPUiTM	4	1.4	2	0.9	0	0	3	2	0	0	1	1	0	0	0	0	0	0	0	0
Mahkota Medical Centre	3	1.1	1	0.5	2	2.5	1	0.7	0	0	0	0	0	0	0	0	0	0	3	3.3
Total	**249**	**89.2**	**183**	**85.8**	**79**	**99**	**146**	**96.2**	**121**	**75.7**	**62**	**63.3**	**75**	**67**	**49**	**53.9**	**81**	**70.5**	**71**	**78.8**

Table 10.1.4 (b): Place of overseas transplantation, 2014-2023

	2023		2022		2021		2020		2019		2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
	Overseas Transplant																			
Cambodia	23	8.2	27	12.7	0	0	3	2	28	17.5	22	22.4	17	15.2	17	18.7	5	4.3	0	0
India	3	1.1	2	0.9	0	0	2	1.3	3	1.9	2	2	2	1.8	0	0	2	1.7	1	1.1
China	1	0.4	0	0	0	0	1	0.7	6	3.8	9	9.2	13	11.6	17	18.7	17	14.8	15	16.5
Singapore	1	0.4	0	0	0	0	0	0	1	0.6	2	2	2	1.8	2	2.2	1	0.9	0	0
USA	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vietnam	1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sri Lanka	0	0	1	0.5	0	0	0	0	0	0	0	0	0	0	3	3.3	2	1.7	3	3.3
Pakistan	0	0	0	0	1	1.3	0	0	0	0	1	1	0	0	1	1.1	5	4.3	0	0
Bangladesh	0	0	0	0	0	0	0	0	1	0.6	0	0	0	0	0	0	0	0	0	0
Indonesia	0	0	0	0	0	0	0	0	0	0	0	0	1	0.9	0	0	0	0	0	0
Iraq	0	0	0	0	0	0	0	0	0	0	0	0	1	0.9	0	0	0	0	0	0
Philippine	0	0	0	0	0	0	0	0	0	0	0	0	1	0.9	0	0	1	0.9	0	0
Iran	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.1	0	0	0	0
Tunisia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.1	0	0	0	0
UK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.9	0	0
Total	**30**	**10.9**	**30**	**14.1**	**1**	**1.3**	**6**	**4**	**39**	**24.4**	**36**	**36.6**	**37**	**33.1**	**42**	**46.2**	**34**	**29.5**	**19**	**20.9**

SECTION 10.2: RECIPIENTS' CHARACTERISTICS

The mean age of the transplant recipients was 39 ± 12. Nearly 60% were male and one-fifth had diabetes mellitus. The percentage of incident transplant recipients who were hepatitis B surface antigen positive or positive hepatitis C antibodies were very low. (Table 10.2.1). Hypertension (28%) remained the most commonly reported primary renal disease but it is more likely a co-morbidity instead. Glomerular disease (24.4%) and unknown cause (24.7%) were predominant. Other causes such as autosomal dominant polycystic kidney disease (ADPKD) and obstructive uropathy resulted in less than 5% of ESKD. (Table 10.2.2)

Table 10.2.1: Renal transplant recipients' characteristics, 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
New Transplant Patients	**279**	**213**	**80**	**152**	**160**	**98**	**112**	**91**	**115**	**91**
Age at transplant (years), Mean	39	39	38	36	41	41	42	44	42	39
Age at transplant (years), SD	12	12	12	11	13	15	12	14	13	13
% Male	59	57	50	54	58	66	67	68	59	54
% Diabetic (co-morbid/primary renal disease)	19	15	21	26	20	17	21	22	24	24
% HBsAg positive	1	1	0	1	1	2	2	6	1	0
% Anti-HCV positive	0	0	1	0	1	1	1	1	3	5

Table 10.2.2: Primary causes of end stage renal failure, 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
New transplant patients	**279**	**100**	**213**	**100**	**80**	**100**	**152**	**100**	**160**	**100**
Glomerulonephritis	68	24.4	52	24.4	16	20	50	32.9	47	29.4
Diabetes Mellitus	26	9.3	24	11.3	16	20	12	7.9	23	14.4
Hypertension	78	28	73	34.3	12	15	37	24.3	32	20
Obstructive uropathy	4	1.4	3	1.4	0	0	1	0.7	5	3.1
ADPKD	4	1.4	4	1.9	1	1.3	0	0	5	3.1
Drugs/ toxic nephropathy	1	0.4	0	0	0	0	3	2	2	1.3
Hereditary nephritis	2	0.7	0	0	2	2.5	1	0.7	2	1.3
Unknown	69	24.7	39	18.3	17	21.3	33	21.7	32	20
Others	27	9.7	18	8.5	16	20	15	9.9	12	7.5

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
New transplant patients	**98**	**100**	**112**	**100**	**91**	**100**	**115**	**100**	**91**	**100**
Glomerulonephritis	22	22.4	32	28.6	34	37.4	51	44.3	30	33
Diabetes Mellitus	19	19.4	21	18.8	16	17.6	13	11.3	9	9.9
Hypertension	29	29.6	30	26.8	17	18.7	24	20.9	18	19.8
Obstructive uropathy	3	3.1	6	5.4	0	0	4	3.5	2	2.2
ADPKD	3	3.1	5	4.5	4	4.4	3	2.6	2	2.2
Drugs/ toxic nephropathy	1	1	0	0	1	1.1	0	0	1	1.1
Hereditary nephritis	3	3.1	3	2.7	0	0	1	0.9	4	4.4
Unknown	10	10.2	10	8.9	16	17.6	17	14.8	17	18.7
Others	8	8.2	5	4.5	3	3.3	2	1.7	8	8.8

SECTION 10.3: TRANSPLANT PRACTICES

10.3.1: Type of renal transplantation

The types of kidney transplantation in Malaysia were local living (genetically or emotionally related), local deceased, commercial living, and commercial deceased. (Table 10.3.1)

Local living donor transplantation has steadily risen for the last 5 years, with an exceptional drop in 2021 due to the COVID-19 pandemic. From 2017 onwards, Malaysia performed more than 50 living transplants yearly, with the highest number of 172 cases (61.6%) reported in 2023. Most of the living donor kidney transplants were genetically related contributing about 35.1% of all kidney transplants, and around 25% were contributed by emotionally related living donors.

Meanwhile, the local deceased donor transplant rate has demonstrated a similar pattern, with only 11 cases in 2018, and the number rose to 82 cases in 2023. This number rose significantly compared with the year before. This was partly contributed by the formation of Unit Perolehan Organ Hospital (UPOH) in 2019, which involved 16 focused hospitals in the Ministry of Health Hospitals. The number of local deceased donor transplants will likely increase with the strengthening of this dedicated team.

The proportion of commercial transplantation fluctuated over the past 10 years, with no reported cases in 2021. This was attributed to the travel restrictions imposed during the COVID-19 pandemic. This may also reflect the global stand on unethical transplant practices. However, the proportion of living commercial transplantations remained significant during the post-pandemic period, attributed to about 13.3% of the total number of kidney transplants in 2022, with a reduction in 2023 (7.5%). The peak number of commercial transplants was reported in 2018, contributing to about 27.5% of the cases.

Overall, the total number of kidney transplantations rose steadily for the last 5 years, with significant increment in 2023. This was dominated by local living donors, which contributed 60.2% (168/279) of the total transplants performed.

Table 10.3.1: Type of renal transplantation, 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Live donor (genetically related)	98	35.1	94	44.1	40	50.0	64	42.1	58	36.3
Live donor (emotionally related)	72	25.8	47	22.1	25	31.3	42	27.6	34	21.3
Live donor (unknown type)	2	0.7	0	0.0	0	0.0	2	1.3	17	10.6
Deceased donor	82	29.4	43	20.2	15	18.8	40	26.3	30	18.8
Commercial deceased donor	0	0.0	0	0.0	0	0.0	1	0.7	2	1.3
Commercial live donor (living unrelated)	21	7.5	28	13.1	0	0.0	3	2.0	16	10.0
Unknown donor type	4	1.4	1	0.5	0	0.0	0	0.0	3	1.9
Total	**279**	**100**	**213**	**100**	**80**	**100**	**152**	**100**	**160**	**100**

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Live donor (genetically related)	37	37.8	36	32.1	30	33.0	23	20.0	24	26.4
Live donor (emotionally related)	17	17.3	16	14.3	13	14.3	9	7.8	9	9.9
Live donor (unknown type)	4	4.1	4	3.6	3	3.3	3	2.6	0	0.0
Deceased donor	11	11.2	26	23.2	9	9.9	51	44.3	39	42.9
Commercial deceased donor	2	2.0	2	1.8	3	3.3	1	0.9	1	1.1
Commercial live donor (living unrelated)	25	25.5	12	10.7	6	6.6	14	12.2	11	12.1
Unknown donor type	2	2.0	16	14.3	27	29.7	14	12.2	7	7.7
Total	**98**	**100**	**112**	**100**	**91**	**100**	**115**	**100**	**91**	**100**

**Commercial live donor (living unrelated) (Cambodia, China, Sri Lanka), Commercial deceased donor (China),*

***Unknown donor type from overseas transplants*

10.3.2: Biochemical data

Table 10.3.2 summarises the biochemical data and blood pressure for all kidney transplant recipients from 2019 to 2023. The mean serum creatinine was 128.8 ± 80.9 to 130.1 ± 83.1 umol/L over the last 5 years, with stable mean haemoglobin 12.6 ± 1.8 to 12.9 ± 1.9 g/dL. Serum albumin, calcium, and phosphate were within normal ranges post-transplantation.

The mean total and LDL cholesterol generally were at the upper limit of normal ranges. In the year 2023, a proportion of the patients had very high total and LDL cholesterol with maximum values of 11.0 mmol/L and 7.5 mmol/L, respectively. The trend was reducing compared to the readings recorded in the previous years.

The mean systolic blood pressure ranges between 134.7 ± 14.6 to 136.0 ± 15.2 mmHg, and the mean diastolic blood pressure ranges between 79.5 ± 9.1 to 80.8 ± 9.8 mmHg diastolic. In 2023, the highest systolic and diastolic blood pressure values were 208 and 117 mmHg, respectively. This requires special attention, as cardiovascular disease is one of the leading causes of death in post-transplant recipients.

Table 10.3.2: Biochemical data, 2019-2023

Biochemical parameter	Summary	2023	2022	2021	2020	2019
Creatinine, umol/L	n	2361	2084	1976	2054	1945
	Mean	130.1	130.1	131	129.6	128.8
	SD	83.1	83.4	83.3	82.2	80.9
	Median	109.7	109	109	108	109
	Minimum	42.3	43.5	41.7	40	41
	Maximum	980	821.2	970	899	964
Hb, g/dL	n	2361	2084	1976	2054	1945
	Mean	12.6	12.7	12.9	12.8	12.9
	SD	1.8	1.8	1.9	1.9	1.9
	Median	12.8	12.8	12.9	12.9	12.8
	Minimum	6	5.8	5.5	4.1	5.9
	Maximum	18.4	19.8	19.3	18.8	18.2
Albumin, g/L	n	2361	2084	1976	2054	1945
	Mean	39.5	39.5	39.8	40.3	40.6
	SD	4.1	3.9	4	4.2	4.6
	Median	39.9	39.8	40	40.5	41
	Minimum	15	20	18.5	16	16.5
	Maximum	51	51	50.8	51.3	52.5
Calcium, mmol/L	n	2361	2084	1976	2054	1945
	Mean	2.4	2.4	2.3	2.3	2.4
	SD	0.1	0.1	0.1	0.1	0.1
	Median	2.3	2.4	2.3	2.3	2.4
	Minimum	1.4	1.5	1.6	1	1.5
	Maximum	3	3	3.3	3	2.9
Phosphate, mmol/L	n	2361	2084	1976	2054	1945
	Mean	1.1	1.1	1.1	1.1	1.1
	SD	0.2	0.2	0.2	0.3	0.2
	Median	1	1.1	1.1	1.1	1.1
	Minimum	0.5	0.5	0.5	0.5	0.5
	Maximum	3.1	3	2.9	4	3

Biochemical parameter	Summary	2023	2022	2021	2020	2019
Alkaline phosphate (ALP), U/L	n	2361	2084	1976	2054	1945
	Mean	89.1	86.1	84.1	85.3	84.1
	SD	52.2	50.8	43.9	42.6	38.5
	Median	79	77.3	76	76.2	76.3
	Minimum	27	20	21	22.3	20.5
	Maximum	995.3	987	758.8	651	405
ALT, U/L	n	2361	2084	1976	2054	1945
	Mean	25.1	24.4	24	24.6	23.9
	SD	24	23.1	21.4	19.7	18.5
	Median	19.7	19.3	19.7	20	20
	Minimum	4.3	4.6	4.2	4	4
	Maximum	422.1	523	482.5	371	291
Total cholesterol, mmol/L	n	2361	2084	1976	2054	1945
	Mean	5.1	5.1	5	5.1	5.1
	SD	1	1	1	1.1	1
	Median	5.1	5.1	5.1	5.1	5.1
	Minimum	2	1.7	1.6	1.5	1.5
	Maximum	11	11.9	12.2	10.3	9.7
LDL cholesterol, mmol/L	n	2361	2084	1976	2054	1945
	Mean	2.8	2.9	2.8	2.8	2.8
	SD	0.8	0.9	0.9	0.9	0.8
	Median	2.8	2.8	2.8	2.8	2.8
	Minimum	0.9	0.9	1	0.9	0.9
	Maximum	7.5	8.7	8.4	7.3	6.7
HDL cholesterol, mmol/L	n	2361	2084	1976	2054	1945
	Mean	1.5	1.5	1.5	1.6	1.5
	SD	0.4	0.4	0.5	0.5	0.4
	Median	1.5	1.5	1.5	1.5	1.5
	Minimum	0.6	0.6	0.6	0.4	0.6
	Maximum	6.9	4.3	8	6.1	5.8
Systolic blood pressure, mmHg	n	2361	2084	1976	2054	1945
	Mean	136	135.4	134.1	135.8	134.7
	SD	15.2	14.6	15.4	15.7	14.6
	Median	135	134.7	132.4	134.8	133.3
	Minimum	88	97	89	95	91.7
	Maximum	208	209	201.7	213	204
Diastolic blood pressure, mmHg	n	2361	2084	1976	2054	1945
	Mean	80.8	80.2	79.6	80.2	79.5
	SD	9.8	9.5	9.2	9.9	9.1
	Median	81	80.5	80	80	80
	Minimum	43	44	46.9	40	47
	Maximum	117	118	115.3	115	115

10.3.3: Immunosuppression medications

Calcineurin-inhibitor-based therapy and corticosteroids remain the mainstay immunosuppressive therapy, with 90.5 % and 85.9% of patients receiving it, respectively. Antimetabolites were used in 67.4% of the patients. The use of proliferation signal inhibitors (PSI) has increased over time from 11.5% in 2019 to 18.4% in 2023. The publication of the transplant efficacy and safety outcomes with an everolimus-based regimen (TRANSFORM trial) in 2018 and 2019 could have explained the increment in its usage Table 10.3.3 (a).

Among the calcineurin inhibitors, the usage of tacrolimus has superseded cyclosporin since 2019. The proportion of patients on tacrolimus had increased from 61.5% in 2019 to 82% in 2023. Mycophenolic mofetil was the main antimetabolite used. The proportion of patients on mycophenolate mofetil was about 50% and mycophenolate sodium around 40% of total anti-metabolites used in post kidney transplant recipients. Azathioprine usage has decreased over the years, from 14.3% in year 2019 to 9.4% of all anti-metabolites used in 2023.

Table 10.3.3 (a): Immunosuppressive Medications, 2019-2023

Medication data	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
All	2361		2084		1976		2054		1945	
Prednisolone	2028	85.9	1907	91.5	1772	89.7	1829	89	1470	75.6
Calcineurin inhibitors	2136	90.5	1889	90.6	1717	87	1795	87.4	1526	78.4
Antimetabolites	1593	67.4	1493	71.6	1378	69.8	1434	69.8	1327	68.3
mTOR inhibitors	433	18.4	348	16.7	319	16.2	302	14.6	224	11.5

Table 10.3.3(b): Immunosuppressive Medications, 2019-2023

Medication data	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
All	2361		2084		1976		2054		1945	
Antimetabolites										
Azathioprine	149	9.4	140	9.4	147	10.7	146	10.2	190	14.3
Mycophenolate Sodium	624	39.2	613	41	555	40.3	589	41.1	477	35.9
Mycophenolic Mofetil	820	51.5	738	49.4	675	49.0	692	48.2	651	49.1
Antimetabolite – unknown type	0	0	2	0.1	1	0.1	7	0.5	9	0.7
Total	1593	100	1493	100	1378	100	1434	100	1327	100
Proliferation Signal Inhibitors										
Everolimus	422	97.5	340	97.7	310	97.2	290	96	205	91.5
Sirolimus	9	2.1	8	2.3	8	2.5	11	3.6	15	6.7
mTOR inhibitor – unknown type	2	0.5	0	0.0	1	0.3	1	0.3	4	1.8
Total	433	100	348	100	319	100	302	100	224	100
Calcineurin inhibitors										
Cyclosporine	384	18.0	423	22.4	468	27.3	517	28.8	562	36.8
Tacrolimus	1751	82.0	1465	77.6	1248	72.7	1274	71.0	938	61.5
Calcineurin inhibitor – unknown type	1	0.0	1	0	1	0.1	4	0.2	26	1.7
Total	2136	100	1889	100	1717	100	1795	100	1526	100
Prednisolone	2028	85.9	1907	91.5	1772	89.7	1829	89	1470	75.6

SECTION 10.4: TRANSPLANT OUTCOMES

10.4.1: Post transplant complications

Hypertension remained the most common comorbidity among kidney transplant recipients before and after transplantation, at 53.1% and 33.0% respectively. Throughout the 5-year period of 2019-2023, the prevalence of pre-transplant hypertension was decremental but that of post-transplant hypertension was incremental.

Diabetes was either the primary kidney disease or a comorbidity in 11.8% of patients before kidney transplant. The incidence of post-transplant diabetes mellitus was trending lower over 5-year period from 2019 to 2023 (Table 10.4.1).

The prevalence of cardiovascular disease and cerebrovascular disease before transplant was 1.7%, and 0.8% developed cardiovascular and/or cerebrovascular disease post-transplantation. The low figure may be due to under-reporting of these comorbidities. Although cancer was rare, it was more common after transplant compared to pre-transplant, 0.5% versus 0.1% (Table 10.4.1).

Table 10.4.1: Post transplant complications, 2019-2023

	Pre transplant comorbidities									
	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
All patients	2185		1965		1867		1944		1856	
Diabetes (Either as primary renal disease or comorbid)	257	11.8	235	12	232	12.4	245	12.6	242	13
Cancer	1	0	2	0.1	1	0.1	2	0.1	3	0.2
Cardiovascular disease + cerebrovascular disorder	37	1.7	32	1.6	28	1.5	30	1.5	29	1.6
Hypertension	1161	53.1	1081	55	1056	56.6	1121	57.7	1081	58.2

	Post transplant complications									
	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
All patients	2185		1965		1867		1944		1856	
Diabetes (new onset)	64	2.9	69	3.5	63	3.4	78	4	92	5
Cancer	12	0.5	11	0.6	14	0.7	11	0.6	20	1.1
Cardiovascular disease + cerebrovascular disorder	18	0.8	17	0.9	17	0.9	26	1.3	34	1.8
Hypertension	721	33	643	32.7	589	31.5	564	29	531	28.6

**Hypertension: BP systolic >140 and BP diastolic >90*
or have either Beta blocker/ Calcium channel blocker / ACE inhibitor / ARBs/ Other antihypertensive

10.4.2: Deaths and graft loss

The death rate of transplant recipients peaked in 2021 with 83 deaths (4.3%). Within the last decade, death rate for year 2023 was the lowest at 2% (Table 10.4.2). The excess deaths in 2021 and 2022 were driven by COVID-19 infection. Infection remained the main cause of death in 2023, similar to previous years. Cardiovascular deaths and cancer deaths in the last 5 years were stable, contributing to 12.5% and 5% of all deaths in 2023, respectively (Table 10.4.3).

The trend of death-censored allograft loss over 5-year period from 2019 to 2023 is encouraging. The overall rate of death-censored allograft loss dropped to 1.7% in 2023 (Table 10.4.2). There were 35 allograft losses in 2023. The two most common reported causes of allograft loss in 2023 were rejection (n=19, 54.3%) followed by IFTA (n=8, 22.9%). Infection, recurrent/de novo glomerular disease and technical issue accounted for two allograft losses (5.7%) each in 2023 (Table 10.4.4).

Table 10.4.2: Transplant patient death rate and graft loss, 2014-2023

Year	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Number at risk	2012	1879	1862	1875	1837	1824	1825	1829	1850	1877
Transplant death	40	74	89	57	53	45	49	49	63	65
Transplant death rate %	2	3.9	4.8	3	2.9	2.5	2.7	2.7	3.4	3.5
Graft loss	35	37	37	43	37	48	28	52	54	44
Graft loss rate %	1.7	2	2	2.3	2	2.6	1.5	2.8	2.9	2.3
Acute rejection	19	11	5	7	12	13	4	20	24	28
Acute rejection rate %	0.9	0.6	0.3	0.4	0.7	0.7	0.2	1.1	1.3	1.5
All losses	75	111	126	100	90	93	77	101	117	109
All losses rate %	3.7	5.9	6.8	5.3	4.9	5.1	4.2	5.5	6.3	5.8

**Graft loss=graft failure*

**All losses=death / graft loss (acute rejection happens concurrently with graft failure / death)*

Figure 10.4.2(a): Transplant recipient death rate, 1990-2023

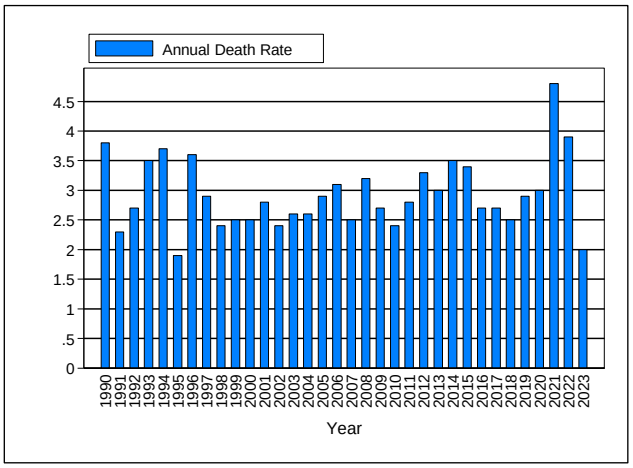


Figure 10.4.2(b): Transplant recipient allograft loss rate, 1990-2023

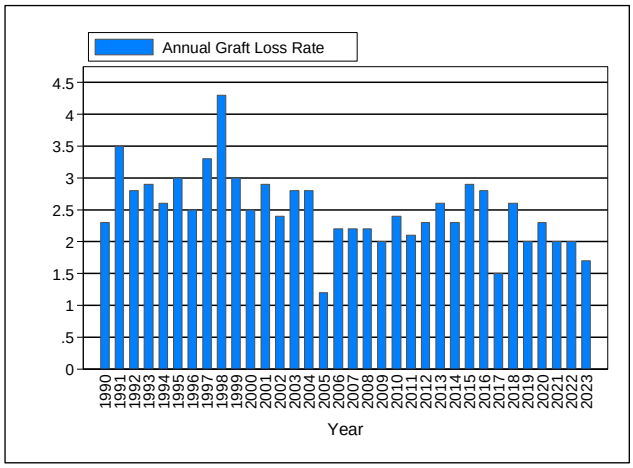


Table 10.4.3: Causes of death in transplant recipients, 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	5	12.5	11	14.9	11	12.4	6	10.5	11	20.8
Died at home	4	10	1	5.4	12	13.5	3	5.3	5	9.4
Infection	13*	32.5	40*	54.1	50*	56.2	27	47.4	17	32.1
Cancer	2	5	8	10.8	6	6.7	6	10.5	11	20.8
Liver disease	0	0	1	1.4	0	0.0	1	1.8	0	0
Accidental death	1	2.5	0	0	0	0.0	1	1.8	0	0
Others	14	35	7	9.5	5	5.6	8	14	6	11.3
Unknown	1	2.5	3	4.1	5	5.6	5	8.8	3	5.7
Total	40	100	74	100	89	100	57	100	53	100

**Death due to COVID-19: 1 in 2023, 16 in 2022, 28 in 2021*

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	4	8.9	6	12.2	13	26.5	16	25.4	14	21.5
Died at home	5	11.1	4	8.2	5	10.2	4	6.3	4	6.2
Infection	20	44.4	22	44.9	13	26.5	28	44.4	31	47.7
Cancer	9	20.0	6	12.2	5	10.2	8	12.7	5	7.7
Liver disease	1	2.2	1	2.0	0	0	1	1.6	1	1.5
Accidental death	0	0.0	0	0.0	2	4.1	0	0	0	0
Others	6	13.3	6	12.2	2	4.1	0	0	3	4.6
Unknown	0	0.0	4	8.2	9	18.4	6	9.5	7	10.8
Total	45	100	49	100	49	100	63	100	65	100

Table 10.4.4: Causes of graft failure, 2014-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Rejection	19	54.3	11	29.7	5	13.5	7	16.3	12	32.4
Calcineurin inhibitor toxicity	0	0	1	2.7	0	0	2	4.7	1	2.7
Other drug toxicity	0	0	0	0	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	0	0	0	0
Infection	2	5.7	2	5.4	2	5.4	2	4.7	0	0
Vascular causes	0	0	0	0	0	0	0	0	0	0
Recurrent/ de novo renal disease	2	5.7	1	2.7	3	8.1	0	0	2	5.4
Chronic allograft nephropathy / IFTA	8	22.9	16	43.2	8	21.6	15	34.9	10	27
Technical problem	2	5.7	0	0	0	0	0	0	0	0
Others	1	2.9	4	10.8	14	37.8	10	23.3	7	18.9
Unknown	1	2.9	2	5.4	5	13.5	7	16.3	5	13.5
Total	35	100	37	100	37	100	43	100	37	100

Year	2018		2017		2016		2015		2014	
	n	%	n	%	n	%	n	%	n	%
Rejection	13	27.1	4	14.3	20	38.5	24	44.4	28	63.6
Calcineurin inhibitor toxicity	1	2.1	2	7.1	4	7.7	2	3.7	0	0
Other drug toxicity	0	0	0	0	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	0	0	0	0
Infection	0	0	1	3.6	2	3.8	1	1.9	2	4.5
Vascular causes	1	2.1	0	0	3	5.8	3	5.6	2	4.5
Recurrent/ de novo renal disease	2	4.2	1	3.6	4	7.7	3	5.6	2	4.5
Chronic allograft nephropathy / IFTA	13	27.1	3	10.7	9	17.3	6	11.1	1	2.3
Technical problem	0	0	0	0	1	1.9	0	0	0	0
Others	7	14.6	3	10.7	1	1.9	2	3.7	2	4.5
Unknown	11	22.9	14	50	8	15.4	13	24.1	7	15.9
Total	48	100	28	100	52	100	54	100	44	100

SECTION 10.5: PATIENT AND ALLOGRAFT SURVIVAL

10.5.1: Patient survival

Patient survival rates have shown significant improvement over the decade (from 2014 to 2023). The survival rate post-kidney transplantation is 97% at 1 year, 92% at 5 years, and 84% at 9 years post transplantation. (Table and Figure 10.5.1(a)).

The analysis identified several risk factors that significantly impact patient survival in kidney transplant recipients. These factors include diabetes mellitus and age of ≥ 40 years and above and kidney transplantation done in the year 2014 till 2018. The mortality of kidney transplantation recipients done in the year 2019 till 2023 has a better outcome comparing to transplantation performed in the year 2014 till 2019. This may reflect better patient selection, and pre- transplant preparation of the recipients.

Interestingly, in previous analysis, recipients with positive hepatitis B and C status, autosomal dominant polycystic kidney disease (ADPKD) and recipients of deceased donor kidney transplants exhibited a higher risk of mortality which are no more significant now.

Table 10.5.1(a): Patient survival, 2014-2023

Interval (years)	n	% Survival	SE
0	1416	100	
1	1038	97	0
2	805	97	1
3	702	96	1
4	537	94	1
5	379	92	1
6	290	90	1
7	194	89	1
8	119	85	2
9	53	84	2
10	1		

**n=Number at risk SE=standard error*

Figure 10.5.1(a): Patient survival, 2014-2023

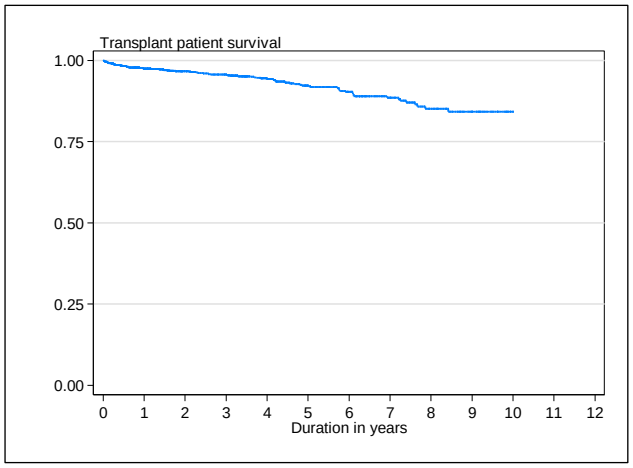


Table 10.5.2(a): Allograft survival, 2014-2023

Interval (years)	n	% Survival	SE
0	1416	100	
1	1038	97	0
2	805	96	1
3	702	95	1
4	537	94	1
5	379	92	1
6	290	91	1
7	194	90	1
8	119	86	2
9	53	85	2
10	1		

**n=Number at risk SE=standard error*

Figure 10.5.2(a): Allograft survival, 2014-2023

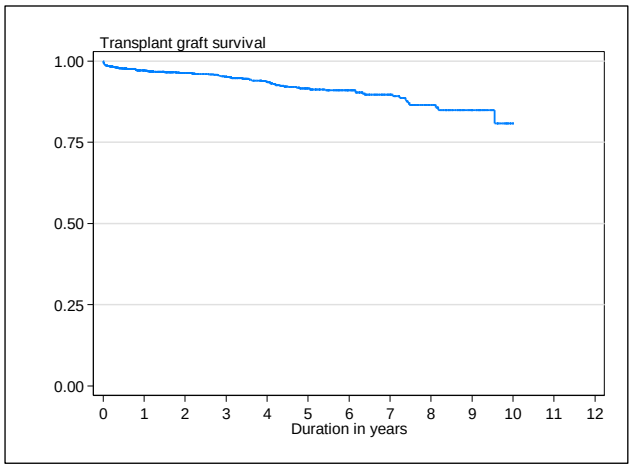


Table 10.5.1(b): Risk factors for transplant recipient mortality 2014-2023

Factors	n	Hazard Ratio	95% CI	P value
Year of transplant				
2014-2018 (ref*)	496	1.00		
2019-2023	872	0.58	(0.34, 0.986)	0.044
Age at transplant				
20-39 (ref*)	700	1.00		
40-54	594	2.26	(1.348, 3.793)	0.002
>=55	112	3.92	(2.017, 7.605)	<0.001
Gender				
Male (ref*)	873	1.00		
Female	608	1.19	(0.769, 1.829)	0.439
Primary diagnosis				
Unknown primary (ref*)	298	1.00		
Diabetes mellitus	180	2.07	(1.01, 4.237)	0.047
GN/SLE	410	1.12	(0.56, 2.221)	0.757
Polycystic kidney	32	1.69	(0.476, 5.99)	0.417
Obstructive nephropathy	28	0.62		
Others	530	1.01	(0.501, 2.027)	0.983
Type of transplant				
Commercial deceased donor (ref*)	18	1.00		
Commercial living donor	146	2.13	(0.278, 16.416)	0.466
Living donor	835	0.91	(0.122, 6.829)	0.929
Deceased donor	374	2.48	(0.335, 18.366)	0.374
HBsAg				
Negative (ref*)	1338	1.00		
Positive	20	2.38	(0.578, 9.777)	0.23
Anti-HCV				
Negative (ref*)	1332	1.00		
Positive	10	1.71	(0.235, 12.435)	0.596

10.5.2 Allograft survival

The allograft loss rates provided below were not censored for death. The allograft survival rates post-kidney transplantation were 97% at 1 year, 92% at 5 years, and 85% at 9 years post-transplantation. Notably, kidney allograft survival rates have shown significant improvement since 2019.

Table 10.5.2(b): Risk factors for allograft loss 2014-2023

Factors	n	Hazard Ratio	95% CI	P value
Year of transplant				
2014-2018 (ref*)	496	1.00		
2019-2023	872	0.64	(0.446, 0.921)	0.016
Age at transplant				
20-39 (ref*)	700	1.00		
40-54	594	1.31	(0.94, 1.834)	0.111
>=55	112	1.60	(0.948, 2.712)	0.078
Gender				
Male (ref*)	873	1.00		
Female	608	1.07	(0.792, 1.456)	0.646
Primary diagnosis				
Unknown primary (ref*)	298	1.00		
Diabetes mellitus	180	1.10	(0.648, 1.855)	0.732
GN/SLE	410	0.90	(0.57, 1.41)	0.636
Polycystic kidney	32	0.68	(0.208, 2.239)	0.529
Obstructive nephropathy	28	0.75		
Others	530	1.06	(0.683, 1.644)	0.795
Type of transplant				
Commercial deceased donor (ref*)	18	1.00		
Commercial living donor	146	0.95	(0.28, 3.253)	0.941
Living donor	835	0.80	(0.249, 2.554)	0.703
Deceased Donor	374	1.62	(0.507, 5.2)	0.415
HBsAg				
Negative (ref*)	1338	1.00		
Positive	20	0.93	(0.229, 3.748)	0.915
Anti-HCV				
Negative (ref*p	1332	1.00		
Positive	10	2.06	(0.655, 6.5)	0.216

10.5.3: Patient survival according to type of transplant

Patient survival following local living renal transplants were 98% at 1 year and 96% at 5 years post transplantation. Local deceased donor recipients survival had improved at 1-year from 92% in 2017 (24th MDTR report) to 96% in 2023 and at 5 -years, from 85% (24th MDTR report) to 87% in 2023. (Table & Figure 10.5.3).

In comparison, Patients who received commercial live donor kidney transplants exhibited similar survival rates to local living program.

Overall, patient survival for commercial deceased donor kidney transplantations was the lowest among all transplant types after 6 years post kidney transplantation. The reason for this was probably likelihood of recipients underlying co-morbidities. However, the number is too small to make a firm conclusion.

10.5.4: Allograft survival according to type of transplant

The allograft survival rates reported were not censored for death. Local living donor allograft survival at 1-year, and 3-years, was 97% and 96% respectively. The allograft survival of commercial living donor and commercial deceased donor transplant were similar to that of local living transplant. Local deceased transplant had the worst allograft survival; 95% at 1 year and 89% at 3 years. (Table 10.5.4)

Table 10.5.3: Unadjusted patient survival by type of transplant, 2014-2023

Type of Transplant Interval (years)	Commercial Deceased Donor			Commercial Living Donor			Local Living Donor			Local Deceased Donor		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	19	100		152	100		862	100		387	100	
1	16	100	0	112	98	1	584	98	1	239	96	1
2	15	100	0	83	98	1	443	98	1	186	94	1
3	15	100	0	79	96	2	372	98	1	168	92	2
4	13	100	0	71	94	2	266	97	1	124	91	2
5	8	100	0	55	89	4	180	96	1	93	87	3
6	7	100	0	37	87	4	128	95	1	80	84	3
7	4	75	22	23	85	5	82	95	1	57	82	3
8	3	75	22	20	85	5	42	91	3	46	77	4
9	3	75	22	11	79	7	21	91	3	17	77	4
10	1			1			1			1		

**n=number at risk SE=standard error*

Figure 10.5.3: Patient survival by type of transplant, 2014-2023

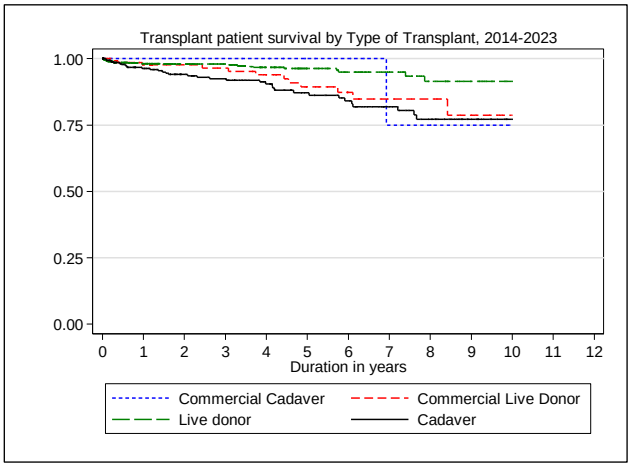


Figure 10.5.4: Graft survival by type of transplants, 2014-2023

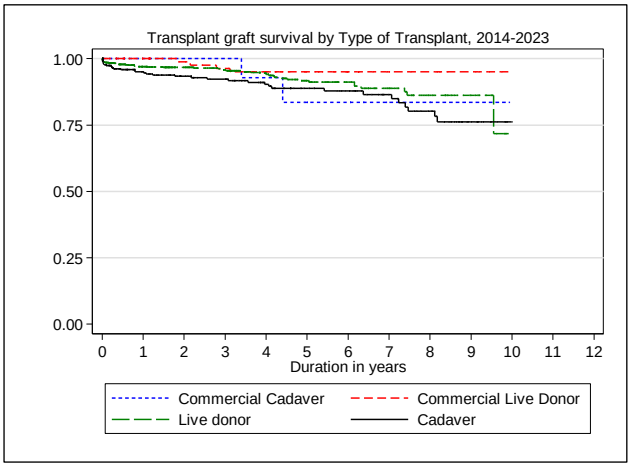


Table 10.5.4: Allograft survival by type of transplant, 2014-2023

Type of Transplant Interval (years)	Commercial Deceased Donor			Commercial Living Donor			Living Donor			Deceased Donor		
	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE	n	% Survival	SE
0	19	100		152	100		862	100		387	100	
1	16	100	0	112	100	0	584	97	1	239	95	1
2	15	100	0	83	99	1	443	97	1	186	93	1
3	15	100	0	79	96	2	372	96	1	168	92	2
4	13	93	7	71	95	2	266	94	1	124	90	2
5	8	84	11	55	95	2	180	92	1	93	89	2
6	7	84	11	37	95	2	128	91	2	80	88	2
7	4	84	11	23	95	2	82	89	2	57	87	3
8	3	84	11	20	95	2	42	86	3	46	80	4
9	3	84	11	11	95	2	21	86	3	17	76	5
10	1			1			1			1		

**n=Number at risk SE=standard error*

10.5.5: Outcome of living donor kidney transplantation

Patient survival of local living donor kidney transplant appeared to be similar in those transplanted in 2014-2018 compared to those transplanted in 2019-2023. However, allograft survival (not censored for death) was better for the cohort that had transplantation done from 2019-2023 (Table & Figure 10.5.5 (a)&(b)).

Table 10.5.5(a): Patient survival by year of transplant (Living related transplant, 2014-2023)

Year of Transplant Interval (years)	2014-2018			2019-2023		
	n	% Survival	SE	n	% Survival	SE
0	211	100		586	100	
1	197	98	1	388	98	1
2	196	98	1	248	98	1
3	194	98	1	179	98	1
4	189	98	1	78	95	2
5	179	97	1	2		
6	128	96	2	2		
7	82	96	2	2		
8	42	92	3	2		
9	21	92	3	2		
10	1			2		

**n=number at risk SE=standard error*

Table 10.5.5(b): Allograft survival by year of transplant (Living related transplant, 2014-2023)

Year of Transplant Interval (years)	2014-2018			2019-2023		
	n	% Survival	SE	n	% Survival	SE
0	211	100		596	100	
1	197	95	1	388	98	1
2	196	95	1	248	97	1
3	194	95	2	179	96	1
4	189	93	2	78	95	1
5	179	90	2	2		
6	128	90	2	2		
7	82	87	2	2		
8	42	85	3	2		
9	21	85	3	2		
10	1			2		

**n=number at risk SE=standard error*

Figure 10.5.5(a): Patient survival by year of transplant (Living related transplant, 2014-2023)

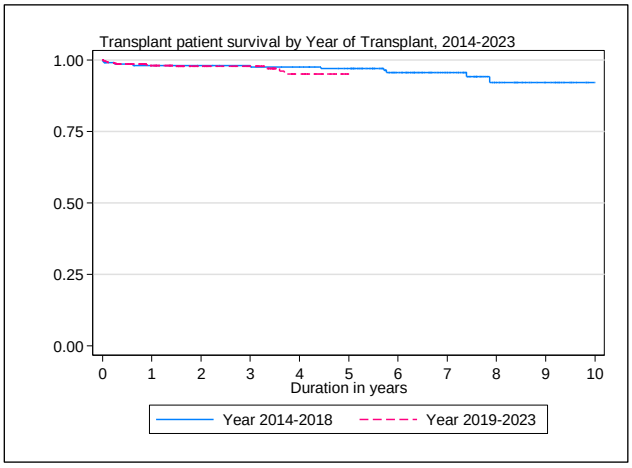
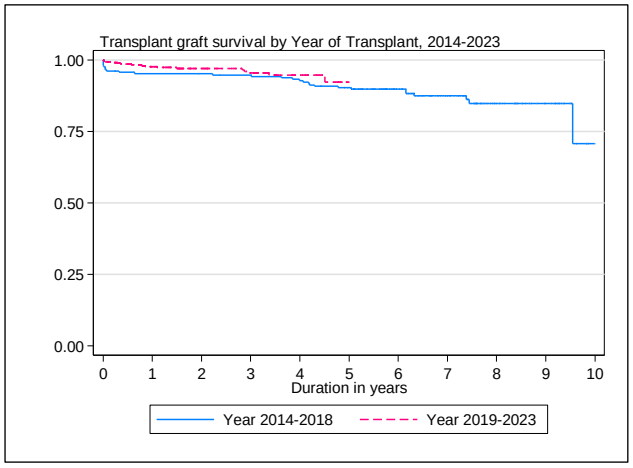


Figure 10.5.5(b): Allograft survival by year of transplant (Living related transplant, 2014-2023)



10.5.6 Outcome of commercial deceased donor transplantation

Patient and allograft survival (not censored for death) of commercial deceased donor transplant appeared to be better only the first 5-6 years and 4-5 years post kidney transplantation for 2014-2018 and 2019-2023 cohort respectively. However, the small number of commercial renal transplants in the cohort may have skewed the result (Table& Figure 10.5.6 (a &b)).

Table 10.5.6(a): Patient survival by year of transplant (Commercial deceased donor transplant, 2014-2023)

Year of Transplant Interval (years)	2014-2018			2019-2023		
	n	% Survival	SE	n	% Survival	SE
0	11	100		6	100	
1	11	100	22	6	100	11
2	10	100	22	6	100	10
3	10	100	22	6	100	10
4	10	100	22	4	100	10
5	8	100	22	1		8
6	7	100	22	1		7
7	4	75	22	1		4
8	3	75	22	1		3
9	3	75	22	1		3
10	1			1		1

**n=number at risk SE=standard error*

Table 10.5.6(b): Allograft survival by year of transplant (commercial deceased donor transplant, 2014-2023)

Year of Transplant Interval (years)	2014-2018			2019-2023		
	n	% Survival	SE	n	% Survival	SE
0	11	100	10	6	100	18
1	11	100	10	6	100	18
2	10	100	10	6	100	18
3	10	100	10	6	100	18
4	10	100	10	4	80	18
5	8	89	10	1		
6	7	89	10	1		
7	4	89	10	1		
8	3	89	10	1		
9	3	89	10	1		
10	1			1		

**n=number at risk SE=standard error*

Figure 10.5.6(a): Patient survival by year of transplant (Commercial deceased donor, 2014-2023)

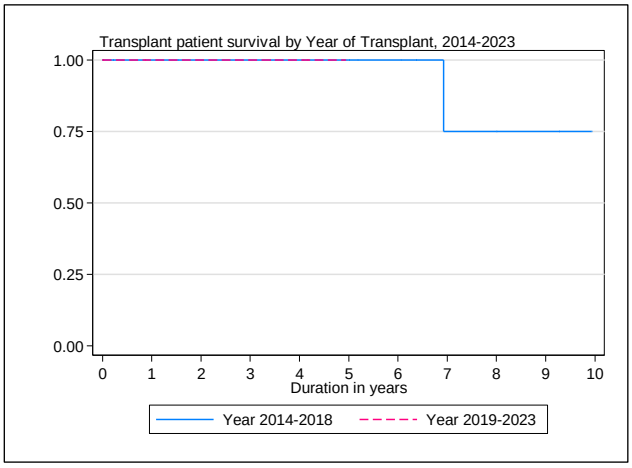
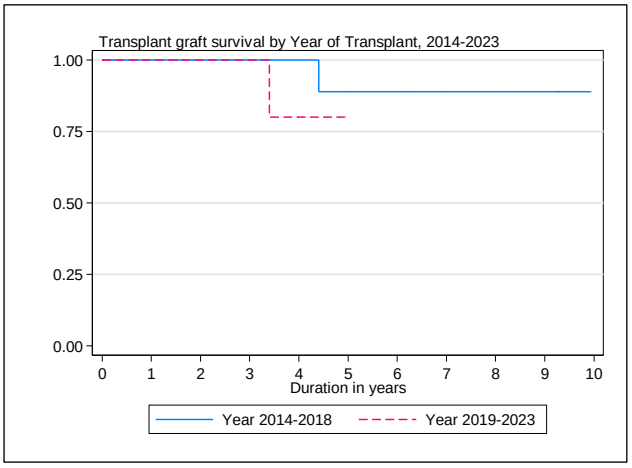


Figure 10.5.6(b): Allograft survival by year of transplant (Commercial deceased donor, 2014-2023)



SECTION 10.6: CARDIOVASCULAR RISK IN RENAL TRANSPLANT RECIPIENTS

10.6.1: Risk factors for ischaemic heart disease (IHD)

The prevalence of hypertension among renal transplant recipients stood at 87.2% in 2023, while 16.8% were diagnosed with diabetes and 49.6% had chronic kidney disease (CKD) stage III and above. Notably, 5.2% of these patients had all three major risk factors for cardiovascular disease (CVD). Although hypertension appears to be on the rise, the prevalence of CKD, diabetes, and composite major risk factors for CVD has shown a declining trend in recent years.

Table 10.6.1: Risk factors for IHD in renal transplant recipients at year 2019-2023

	2019	2020	2021	2022	2023
Diabetes	46 (2.8)	46 (2.6)	25 (1.4)	31 (1.7)	38 (1.9)
Hypertension**	656 (39.3)	723 (40.6)	722 (41.6)	733 (40.1)	812 (39.7)
CKD	141 (8.4)	145 (8.2)	129 (7.4)	132 (7.2)	201 (9.8)
Diabetes + Hypertension**	164 (9.8)	166 (9.3)	160 (9.2)	178 (9.7)	178 (8.7)
Diabetes + CKD	25 (1.5)	20 (1.1)	19 (1.1)	20 (1.1)	20 (1.0)
CKD + Hypertension**	524 (31.4)	568 (31.9)	567 (32.6)	629 (34.4)	687 (33.6)
Diabetes + CKD + Hypertension**	113 (6.8)	111 (6.2)	115 (6.6)	104 (5.7)	107 (5.2)

***Hypertension: BP systolic > 140 and BP diastolic > 90 OR have either Beta blocker / Calcium channel blocker / ACE inhibitor / AIIRB / Other antihypertensive drugs*
*eGFR (ml/min/1.73m2) = 41.3 * (height (cm) / 100 / (Creatine in umol/L) / 88.4) if age<18*
CKD-EPI Cr Equation (2021) is used if age>=18 CKD stage III-GFR, 30-60 CKD stage IV-GFR, 15-30 CKD stage V-GFR, <15

Figure 10.6.1(a): Venn diagram for pre and post-transplant complications (in %) at year 2019

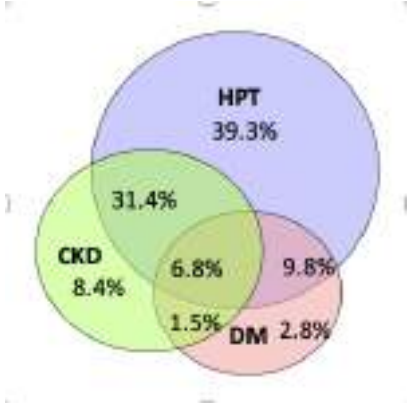


Figure 10.6.1(b): Venn diagram for pre and post-transplant-complications (in %) at year 2020

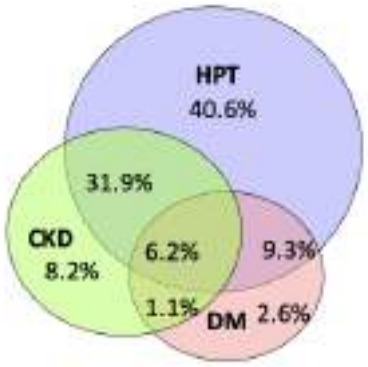


Figure 10.6.1(c): Venn diagram for pre and post-transplant complications (in %) at year 2021

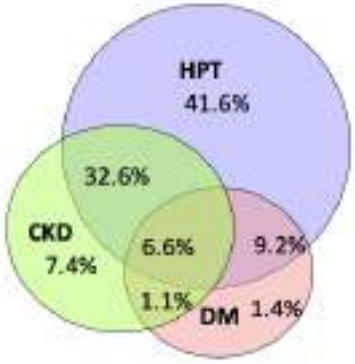


Figure 10.6.1(d): Venn diagram for pre and post-transplant complications (in %) at year 2022

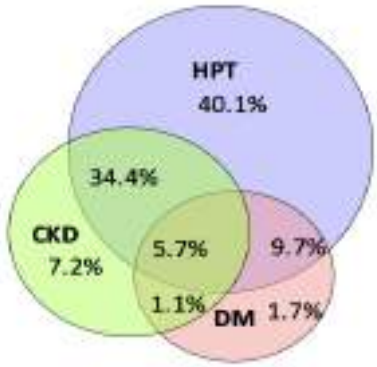
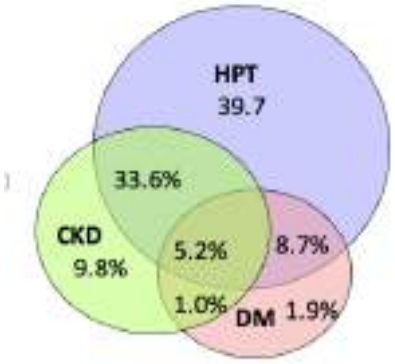


Figure 10.6.1(e): Venn diagram for pre and post-transplant complications (in %) at year 2023



10.6.2: Blood Pressure

Despite the increasing prevalence of hypertension among renal transplant recipients, their blood pressure has remained stable over the last 5 years. In 2023, 35.7% of recipients had a systolic blood pressure of ≥ 140mmHg, and 17.1% had a diastolic blood pressure of ≥ 90mmHg.

Table 10.6.2(a): Systolic BP, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<120	287	12.3	264	12.8	296	15.3	282	13.9	239	12.5
120-129	494	21.2	459	22.2	551	28.5	455	22.5	477	25
130-139	716	30.7	629	30.5	495	25.6	533	26.3	554	29
140-159	672	28.8	593	28.7	468	24.2	616	30.4	537	28.1
160-179	136	5.8	104	5	104	5.4	111	5.5	89	4.7
>=180	25	1.1	14	0.7	18	0.9	26	1.3	14	0.7

Figure 10.6.2(a): Systolic BP, 2019-2023

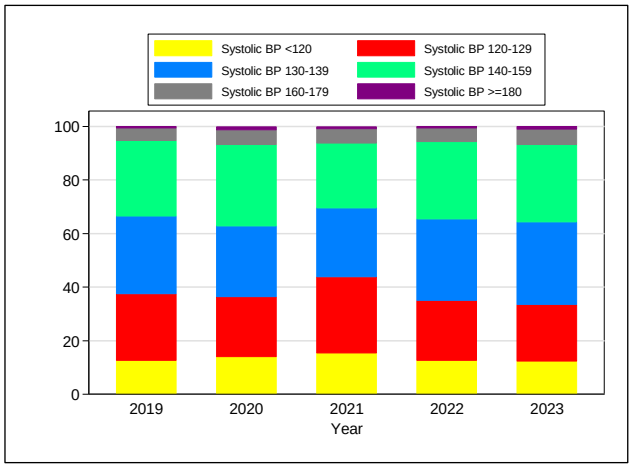


Figure 10.6.2(b): Diastolic BP, 2019-2023

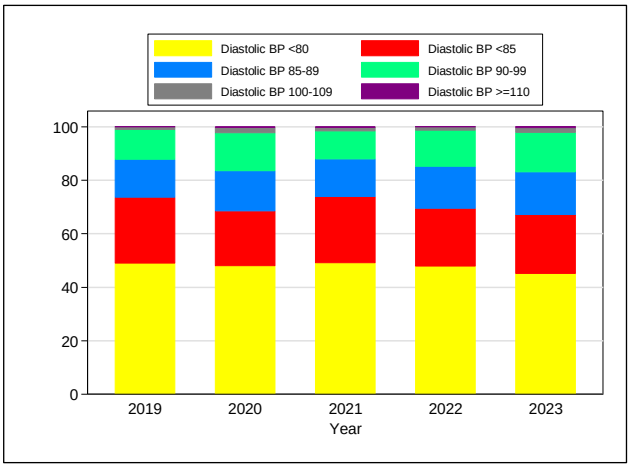


Table 10.6.2(b): Diastolic BP, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<80	1045	45	982	47.9	953	49	973	48	939	48.9
80-84	510	22	442	21.5	482	24.8	415	20.5	472	24.6
85-89	370	15.9	321	15.6	274	14.1	302	14.9	272	14.2
90-99	344	14.8	276	13.5	202	10.4	288	14.2	215	11.2
100-109	41	1.8	27	1.3	30	1.5	42	2.1	22	1.1
>=110	11	0.5	4	0.2	3	0.2	6	0.3	1	0.1

10.6.3: Blood pressure control

The proportion of renal transplant recipients receiving treatment for hypertension has remained consistent over the past 5 years. Approximately three-quarter of renal transplant recipients received treatment for hypertension in 2023, including 38% who required two or more antihypertensive agents. Seven percent of patients had a systolic blood pressure of ≥ 160mmHg and 17% had a diastolic blood pressure of ≥ 90mmHg despite being on treatment.

Table 10.6.3(a): Treatment for hypertension, 2019-2023

Year	n	% on anti-hypertensives	% on 1 antihypertensive drug	% on 2 antihypertensives	% on 3 antihypertensives
2019	1945	73	32	27	11
2020	2054	74	34	29	9
2021	1976	77	34	30	11
2022	2084	77	35	30	10
2023	2361	73	34	28	10

Table 10.6.3(b): Distribution of systolic BP without antihypertensives, 2019-2023

Year	n	Mean	SD	Median	LQ	UQ	% Patients ≥ 160mmHg
2019	517	131.1	15.6	130	121.3	139.9	4
2020	530	130.8	16.3	129	120	139	5
2021	437	128.9	15.6	127	119	136.3	5
2022	482	131	16	130	121	139.3	5
2023	631	132.3	15.1	132.3	122.3	140	5

Table 10.6.3(c): Distribution of diastolic BP without antihypertensives, 2019-2023

Year	n	Mean	SD	Median	LQ	UQ	% Patients ≥ 90mmHg
2019	517	79.3	8.9	79.8	73	85	12
2020	530	79.6	9.7	80	72.5	86.3	15
2021	437	79.3	9.1	80	73.3	85.3	10
2022	482	80.2	9.8	80	74	87	16
2023	631	80.4	10	80.3	74	87	18

Table 10.6.3(d): Distribution of systolic BP on antihypertensives, 2019-2023

Year	n	Mean	SD	Median	LQ	UQ	% Patients ≥ 160mmHg
2019	1413	136.1	14	135	127	144.3	6
2020	1518	137.6	15.2	136.7	128	146.8	7
2021	1519	135.5	15.1	134	125.3	144	7
2022	1594	136.8	14	135.6	127.8	145	6
2023	1728	137.4	15	135.5	128	145.3	7

Table 10.6.3(e): Distribution of diastolic BP on antihypertensives, 2019-2023

Year	n	Mean	SD	Median	LQ	UQ	% Patients ≥ 90 mmHg
2019	1413	79.5	9.2	80	73.8	85.3	13
2020	1518	80.3	10	80.3	74	87	17
2021	1519	79.8	9.4	80	74	85.5	13
2022	1594	80.2	9.5	80.6	74	86.3	15
2023	1728	81	9.7	81	74.9	87.3	17

10.6.4: Allograft function

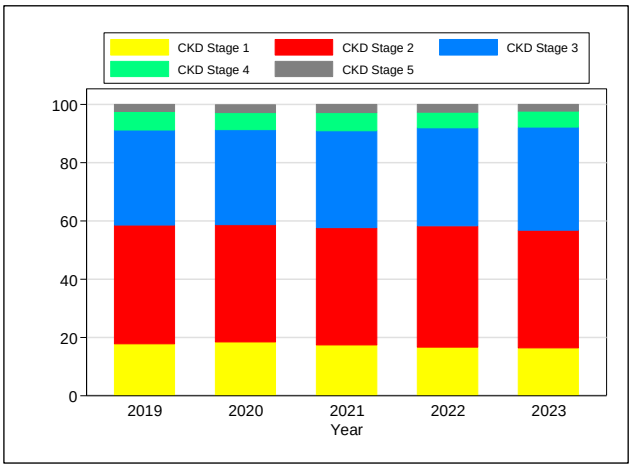
Prevalence of CKD in renal transplant recipients according to CKD stage over the last 5 years was similar. In 2023, 35.5% had CKD stage III and 7.7 % had CKD stage IV and above.

Table 10.6.4: CKD stages, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
Stage 1	390	16.5	353	16.9	338	17.1	372	18.2	335	17.3
Stage 2	949	40.2	848	40.7	804	40.8	833	40.7	801	41.3
Stage 3	838	35.5	704	33.7	651	33	660	32.2	631	32.5
Stage 4	130	5.5	124	5.9	120	6.1	125	6.1	131	6.8
Stage 5	52	2.2	57	2.7	59	3	59	2.9	41	2.1

*eGFR (ml/min/1.73m2) = 41.3 * (height (cm) / 100) / (Creatine in umol/L) / 88.4) if age<18*
CKD-EPI Creatinine Equation (2021) is used if age>=18
CKD stage I-GFR, 90-130 CKD stage II-GFR, 60-90 CKD stage III-GFR, 30-60 CKD stage IV-GFR, 15-30 CKD stage V-GFR, <15

Figure 10.6.4: CKD stages by year



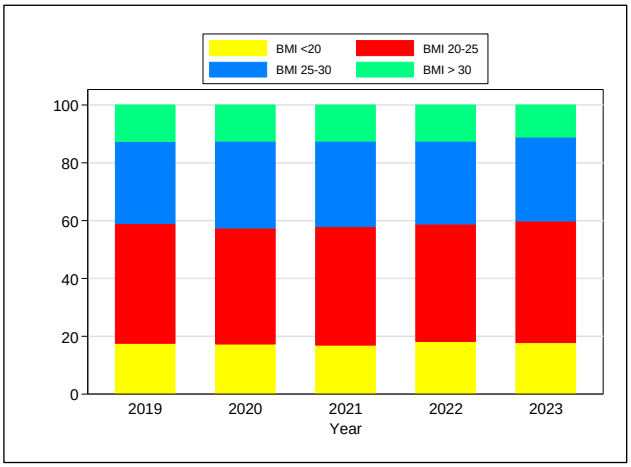
10.6.5: Body mass index (BMI)

The body mass index (BMI) of renal transplant recipients in the recent 5 years remains static. In 2023, more than a third were overweight and 10.9% were obese.

Table 10.6.5: BMI, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<20	315	17.5	287	18.6	244	16.9	283	17.2	264	17.4
20-25	764	42.5	628	40.8	587	40.8	669	40.6	616	40.7
25-30	522	29	426	27.7	427	29.7	495	30	440	29.1
> 30	196	10.9	198	12.9	182	12.6	202	12.2	193	12.8

Figure 10.6.5: BMI, 2019-2023



10.6.6: LDL cholesterol

The latest data reveals a concerning trend in the lipid profile of renal transplant recipients, with a worsening of lipid parameters between 2019 and 2023. In 2023, 62.1% of these recipients had LDL ≥ 2.6mmol/L, while 11.4% had total cholesterol >6.2mmol/L and 5.6% had HDL <1mmol/L.

Table 10.6.6(a): LDL, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
< 2.6	897	37.9	724	34.7	850	43	851	41.4	686	35.3
2.6-3.4	990	41.8	883	42.3	721	36.5	800	38.9	940	48.3
>= 3.4	481	20.3	481	23	405	20.5	403	19.6	319	16.4

Table 10.6.6(b): Total cholesterol, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<4.1	335	14.1	292	14	346	17.5	351	17.1	287	14.8
4.1-5.1	1123	47.4	924	44.3	848	42.9	874	42.6	973	50
5.1-6.2	642	27.1	602	28.8	548	27.7	565	27.5	461	23.7
6.2- 7.2	198	8.4	198	9.5	178	9	192	9.3	163	8.4
> 7.2	70	3	72	3.4	56	2.8	72	3.5	61	3.1

Table 10.6.6(c): HDL, 2019-2023

Year	2023		2022		2021		2020		2019	
	n	%	n	%	n	%	n	%	n	%
<1	132	5.6	119	5.7	124	6.3	118	5.7	134	6.9
1-1.3	533	22.5	562	26.9	503	25.5	483	23.5	434	22.3
>1.3	1703	71.9	1407	67.4	1349	68.3	1453	70.7	1377	70.8

Figure 10.6.6(a): LDL, 2019-2023

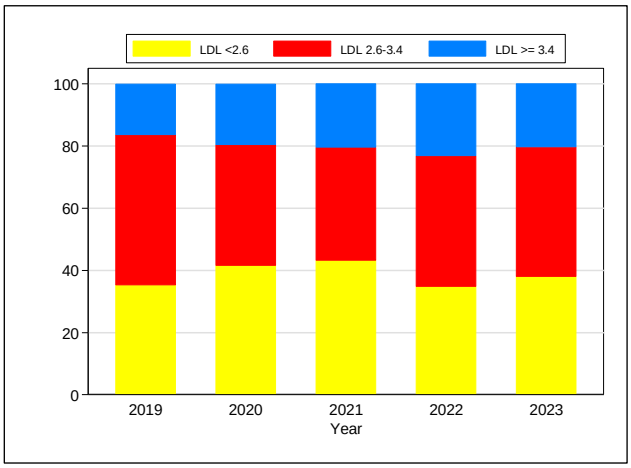


Figure 10.6.6(b): Total cholesterol, 2019-2023

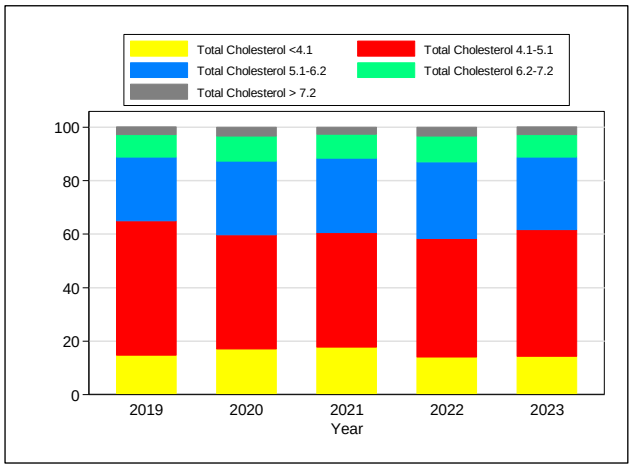
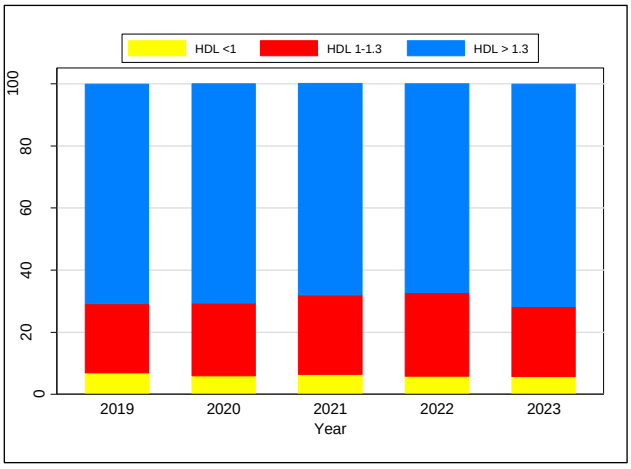


Figure 10.6.6(c): HDL, 2019-2023



SECTION 10.7: QOL INDEX SCORE IN KIDNEY TRANSPLANT RECIPIENTS

The Spitzer QoL index scores of 1165 kidney transplant recipients, who underwent transplantation between 2014 and 2023, were high. At least 95% of all kidney transplant recipients reported QOL index score of 10 (Table & Figure 10.7.1). Further analysis revealed no significant differences in QoL index scores between diabetics and non-diabetics (Table & Figure 10.7.2), gender (Table & Figure 10.7.3), or age groups (Table & Figure 10.7.4). Kidney transplant recipients aged 60 years old and above had the same median QoL index score of 10 as their younger counterparts. Importantly, the excellent QoL index scores have remained consistent over the last decade (Table & Figure 10.7.5).

Table 10.7.1: Cumulative distribution of QoL-Index score of all kidney transplant recipients 2014-2023

Dialysis modality	QoL score
Number of patients	1165
Centile	
0	0
0.05	9
0.1	10
0.25 (LQ)	10
0.5 (median)	10
0.75 (UQ)	10
0.9	10
0.95	10
1	10

Table 10.7.2: Cumulative distribution of QoL-Index score stratified to diabetes mellitus status among kidney transplant recipients 2014-2023

Diabetes mellitus	No	Yes
Number of patients	1103	62
Centile		
0	0	0
0.05	9	9
0.1	10	10
0.25 (LQ)	10	10
0.5 (median)	10	10
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 10.7.1: Cumulative distribution of QoL-Index score of all kidney transplant recipients 2014-2023

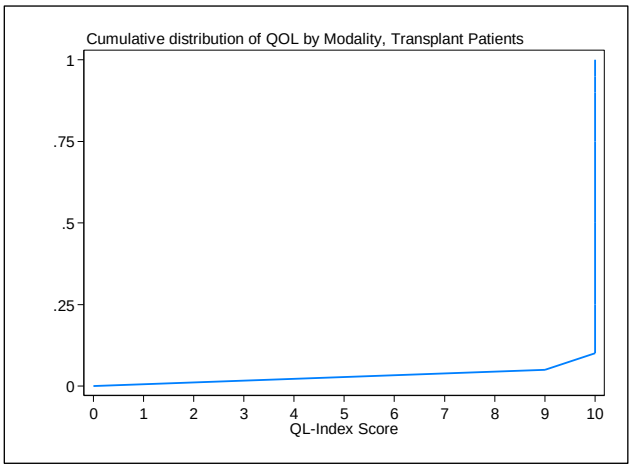


Figure 10.7.2: Cumulative distribution of QoL-Index score stratified to diabetes mellitus status among kidney transplant recipients 2014-2023

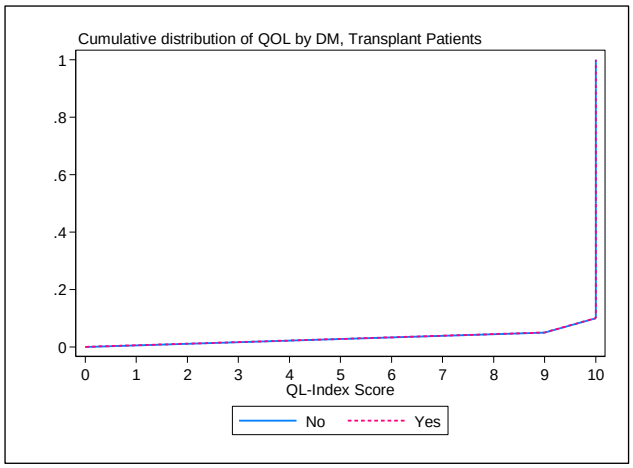


Table 10.7.3: Cumulative distribution of QoL-Index score stratified to gender among kidney transplant recipients 2014-2023

Gender	Male	Female
Number of patients	677	488
Centile		
0	0	0
0.05	10	9
0.1	10	10
0.25 (LQ)	10	10
0.5 (median)	10	10
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 10.7.3: Cumulative distribution of QoL-Index score stratified to gender among kidney transplant recipients 2014-2023

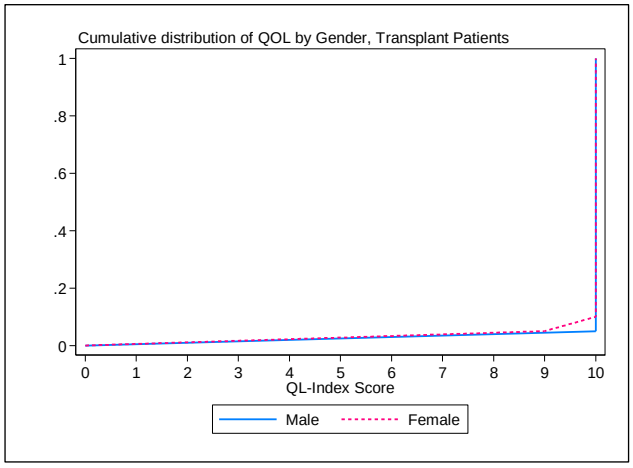


Table 10.7.4: Cumulative distribution of QoL-Index score stratified to age groups among kidney transplant recipients 2014-2023

Age group (years)	<20	20-39	40-59	>=60
Number of patients	58	583	448	76
Centile				
0	0	0	0	0
0.05	7	10	9	8
0.1	9	10	10	9
0.5 (median)	10	10	10	10
0.75 (UQ)	10	10	10	10
0.9	10	10	10	10
0.95	10	10	10	10
1	10	10	10	10

Figure 10.7.4: Cumulative distribution of QoL-Index score stratified to age groups among kidney transplant recipients 2014-2023

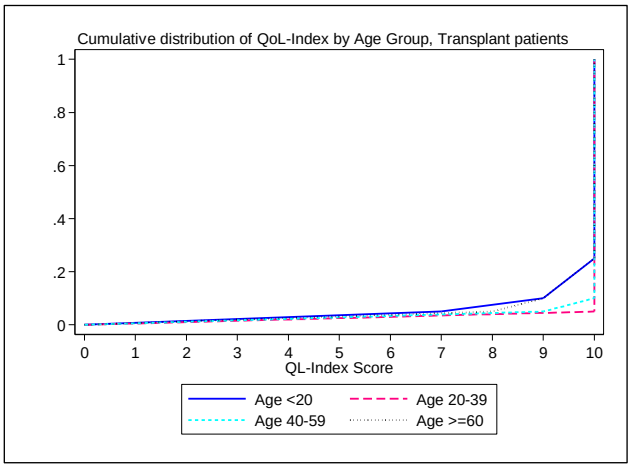


Figure 10.7.5: Cumulative distribution of QoL-Index score stratified to year of entry among kidney transplant recipients 2014-2023

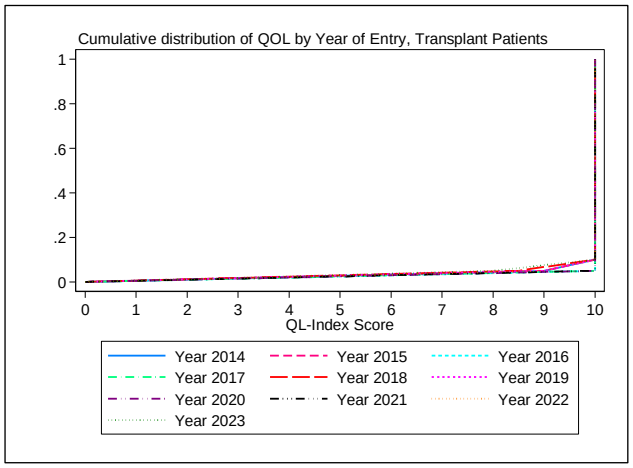


Table 10.7.5: Cumulative distribution of QoL-Index score stratified to year of entry among kidney transplant recipients 2014-2023

Year of Entry	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014
Number of patients	276	206	77	137	131	78	81	62	67	50
Centile										
0	0	0	0	0	0	0	0	0	0	0
0.05	9	9	10	10	8.5	9	10	10	9	8
0.1	10	10	10	10	10	10	10	10	10	10
0.25 (LQ)	10	10	10	10	10	10	10	10	10	10
0.5 (median)	10	10	10	10	10	10	10	10	10	10
0.75 (UQ)	10	10	10	10	10	10	10	10	10	10
0.9	10	10	10	10	10	10	10	10	10	10
0.95	10	10	10	10	10	10	10	10	10	10
1	10	10	10	10	10	10	10	10	10	10

SECTION 10.8: DONOR PROFILE

Total of 621 living kidney donation occurred from 2017 to 2023 (Table 10.8.1). Annual number of living kidney donors in Malaysia increased over the period 2017-2023. Highest recorded number of living kidney donors annually was in year 2023 (n = 164). From 2017 to 2023, living donors are predominantly female (n = 382, 61.5%).

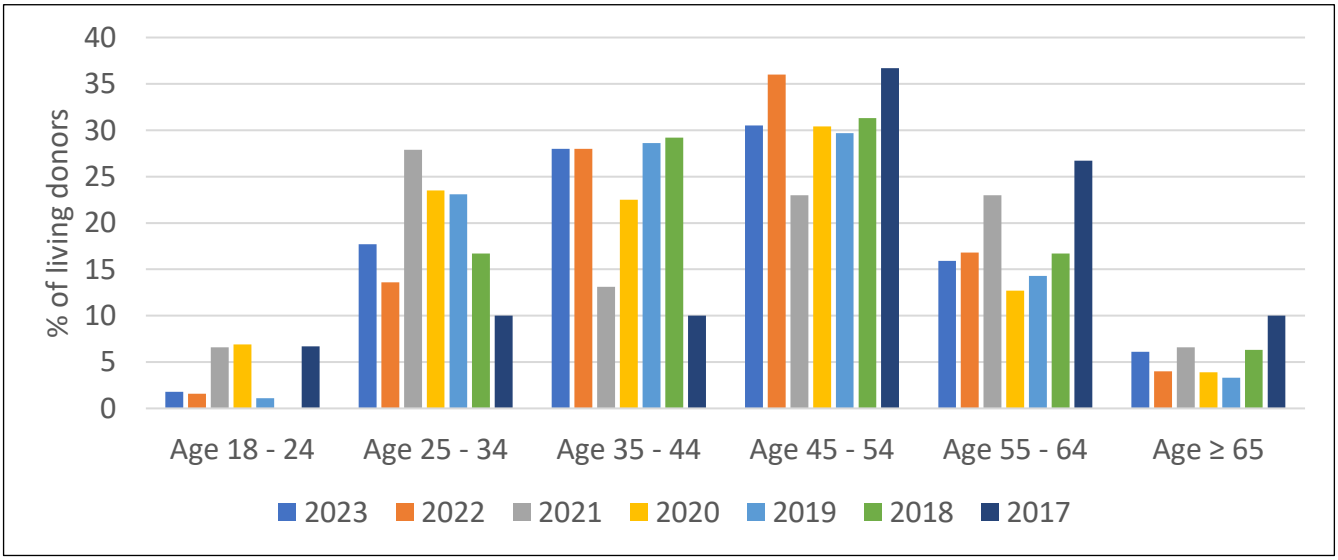
In 2023, the mean age of living kidney donors is 45.2 years old, and 19.5% of living kidney donors were aged 18-34 years old. Ten elderly persons (age ≥ 65 years old) donated their kidneys in 2023, representing 6.1% of all living kidney donors that year. The trend for donor age remains consistent throughout the period 2017- 2023. Living kidney donation trend across different ethnicities in Malaysia is stable from year 2017-2023.

Table 10.8.1: Living Donors of transplants done within Malaysia, 2017-2023

Year of Entry	2023		2022		2021		2020		2019		2018		2017	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Number	164		125		61		102		91		48		30	
Gender														
Male	56	34.1	47	37.6	29	47.5	44	43.1	34	37.4	22	45.8	7	23.3
Female	108	65.9	78	62.4	32	52.5	58	56.9	57	62.6	26	54.2	23	76.7
Age at Donation														
Age 18 - 24	3	1.8	2	1.6	4	6.6	7	6.9	1	1.1	0	0.0	2	6.7
Age 25 - 34	29	17.7	17	13.6	17	27.9	24	23.5	21	23.1	8	16.7	3	10.0
Age 35 - 44	46	28.0	35	28.0	8	13.1	23	22.5	26	28.6	14	29.2	3	10.0
Age 45 - 54	50	30.5	45	36.0	14	23.0	31	30.4	27	29.7	15	31.3	11	36.7
Age 55 - 64	26	15.9	21	16.8	14	23.0	13	12.7	13	14.3	8	16.7	8	26.7
Age ≥ 65	10	6.1	5	4.0	4	6.6	4	3.9	3	3.3	3	6.3	3	10
Mean age (years)	45.2		46		44.3		42.6		43.5		45.2		49.5	
SD	11.2		10.5		13.4		12		11		10.6		13.2	
Median age (years)	45		47		45		43.5		44		45.5		51.5	
Min	23		23		21		21		24		25		20	
Max	71		70		73		70		67		67		74	
Ethnicity														
Malay	85	51.8	68	54.4	31	50.8	55	53.9	51	56.0	24	50.0	16	53.3
Chinese	66	40.2	39	31.2	25	41.0	34	33.3	26	28.6	21	43.8	12	40.0
Indian	9	5.5	13	10.4	5	8.2	8	7.8	6	6.6	3	6.3	2	6.7
Bumiputra Sabah	0	0.0	3	2.4	0	0.0	3	2.9	5	5.5	0	0.0	0	0.0
Bumiputra Sarawak	3	1.8	2	1.6	0	0.0	1	1.0	2	2.2	0	0.0	0	0.0
Other Malaysian	1	0.6	0	0.0	0	0.0	1	1.0	1	1.1	0	0.0	0	0.0

**None of the donors have passed away or progressed to end-stage kidney disease (ESKD), as of December 31, 2023. (Based on the presence of the donor's IC in the MDTR database.)*

Figure 10.8.1: Age distribution among living donors, 2017 to 2023



Malay is the predominant ethnicity among living kidney donors, representing 50.0% - 56.0% of all living donors each year. Living donor among Chinese ranges 28.6% to 43.8%, which is a higher percentage in comparison to population distribution in Malaysia. Based on the statistics in 2023, Chinese constitutes 22-23% of the Malaysian population. Percentage of Indian living donors ranges between 5.5 to 10.8% with an average of 7.4% per year which commensurate with the Indian population distribution. Living donors among Bumiputra Sabah and Sarawak were extremely low suggesting access to living donor kidney transplantation is low in these areas.

CHAPTER 11

PAEDIATRIC RENAL REPLACEMENT THERAPY

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SECTION A: RRT PROVISION FOR PAEDIATRIC PATIENTS

This chapter presents data on patients under 18 years old who have received renal replacement therapy (RRT) for the past seven years (2017-2023). Past reports presented data on paediatric RRT patients under 20 years of age because the previous national population data was divided into groups of 5 years, hence the use of 20 years as a cut-off. As of 2022, we have begun presenting data on patients under 18 years old. The present report will present the data for 2023 in addition to the last six years.

The dialysis acceptance rate for the paediatric population generally had plateaued at around 10-11 per million age-related population (pmarp) for the past decade. The combined incidence of all RRT modalities peaked in 2021 (14 pmarp) and showed a slight decrease in subsequent years. New transplants were notably low; the rate remained at 1 pmarp in other years, highlighting potential challenges in donor availability or eligibility for transplantation in paediatric cases.

The number of patients on haemodialysis (HD) gradually increased from 513 in 2017 to 528 by 2023. Similar to HD, the number of patients on peritoneal dialysis (PD) has also increased, from 281 in 2017 to 340 by 2023. However, the number of functioning transplants remained relatively stable, peaking in 2017 (155) and slightly declining to 139 by 2023.

The number of prevalent paediatric patients on dialysis continued to rise. The prevalence of HD has gradually increased from 54 per million in 2017 to 58 pmarp by 2023, indicating growing utilisation or longer duration of dialysis. PD also showed a steady increase in prevalence, from 30 pmarp in 2017 to 37 pmarp in 2023. Although the dialysis acceptance rate for new PD patients was higher than HD, the prevalent HD patients were consistently higher than PD. This was probably due to a higher incidence of technique failure among PD patients.

The prevalence of functioning grafts remained stable at around 15 pmarp from 2022 onward. The combined prevalence of all RRT modalities was highest in 2018 and 2019 (113 and 114 pmarp, respectively) and remained above 100 per million throughout the study period, indicating a significant burden of renal disease in this population.

Table 11.1: Stock and flow of Paediatric Renal Replacement Therapy (RRT), 2017-2023

Year	2023	2022	2021	2020	2019	2018	2017
New HD patients	21	35	28	34	45	32	33
New PD patients	66	63	67	60	84	58	50
New Transplants	12	6	2	11	7	6	1
HD deaths	33	31	33	15	18	33	15
PD deaths	23	27	23	13	19	14	19
Transplant deaths	3	4	3	2	1	1	2
On HD at 31st December	528	549	549	557	544	513	513
On PD at 31st December	340	350	348	331	320	288	281
Functioning transplant at 31st December	139	138	146	151	149	149	155

Figure 11.1(a): Incidence cases of RRT by modality in children under 18 years old, 2017-2023

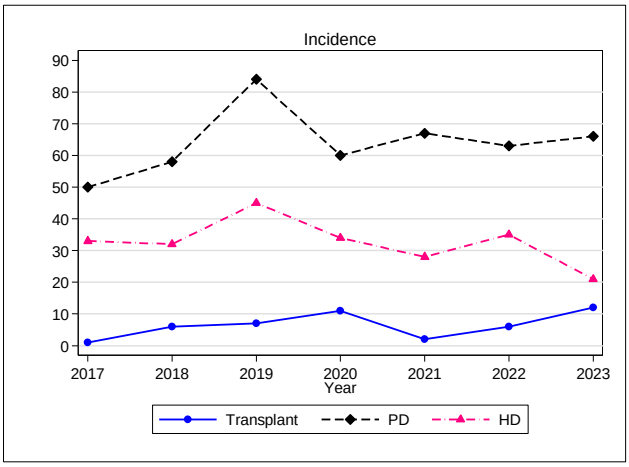


Figure 11.1(b): Prevalence cases of RRT by modality in children under 18 years old, 2017-2023

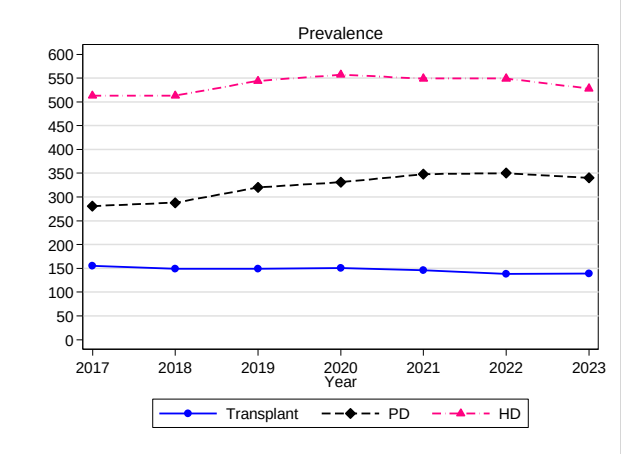
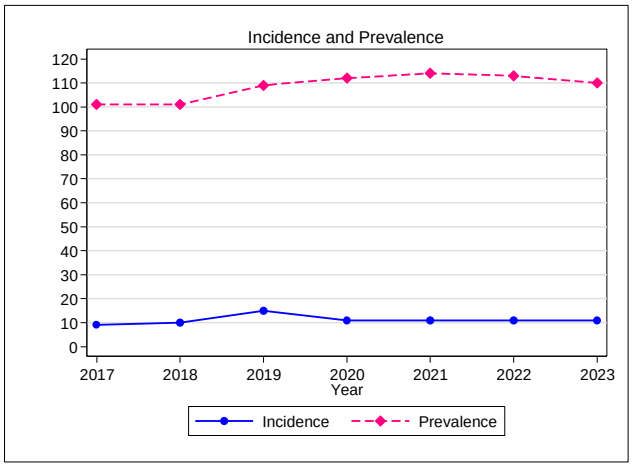


Table 11.2: Paediatric dialysis and transplant rates per million age-related population, 2017-2023

Year	2023	2022	2021	2020	2019	2018	2017
Incidence Rate							
New HD	2	4	3	4	5	3	3
New PD	7	7	7	6	9	6	5
New Transplant	1	1	0	1	1	1	0
All RRT	9	10	14	10	10	11	10
Prevalence Rate at 31st December							
On HD	58	60	60	60	59	55	54
On PD	37	38	38	36	35	31	30
Functioning Graft	15	15	16	16	16	16	16
All RRT	101	101	109	112	114	113	110

Figure 11.2: Incidence and prevalence rate per million age-related population, 2017-2023



SECTION B: DISTRIBUTION OF PAEDIATRIC DIALYSIS PATIENTS

Table 11.3(a): Dialysis treatment rate by state, per million state age-related population, 2017-2023

State	2023	2022	2021	2020	2019	2018	2017	**Average**
Johor	18	19	19	19	21	19	20	**22.5**
Kedah	21	20	22	23	23	21	22	**25.3**
Kelantan	19	18	22	25	24	22	23	**25.5**
Melaka	5	6	6	7	9	8	9	**8.3**
Negeri Sembilan	35	35	33	33	39	31	31	**39.5**
Pahang	25	25	28	25	22	26	25	**29.3**
Perak	17	21	21	22	22	21	20	**24.0**
Perlis	14	14	17	18	24	24	16	**21.2**
Pulau Pinang	28	37	36	34	34	30	34	**38.8**
Sabah WP Labuan	19	19	18	20	17	17	15	**20.8**
Sarawak	33	33	30	28	23	23	22	**32.0**
Selangor	13	14	12	12	12	10	11	**14.0**
Terengganu	32	34	40	31	27	25	28	**36.2**
WP Kuala Lumpur	29	30	30	26	28	26	22	**31.8**

Table 11.3(b): New dialysis patients by state, 2017-2023

State	2023	2022	2021	2020	2019	2018	2017	**Total**
Johor	12	10	9	9	17	9	9	**75**
Kedah	9	3	7	3	9	2	3	**36**
Kelantan	5	2	3	7	9	6	3	**35**
Melaka	2	1	1	1	2	1	2	**10**
Negeri Sembilan	6	9	7	5	15	6	6	**54**
Pahang	5	3	5	5	5	8	5	**36**
Perak	3	4	7	6	7	6	7	**40**
Perlis	0	0	0	1	0	2	0	**3**
Pulau Pinang	6	12	10	12	12	2	8	**62**
Sabah WP Labuan	11	11	6	6	13	14	10	**71**
Sarawak	7	11	10	7	6	6	7	**54**
Selangor	8	17	7	18	12	11	8	**81**
Terengganu	2	3	14	6	8	3	5	**41**
WP Kuala Lumpur	11	12	9	8	14	13	7	**74**

There had been consistently more males compared to females among the population of children on dialysis and transplants. This perhaps reflected the higher incidence of ESKD among males. This trend has persisted over the last six years, although 2023 showed a female predominance (dialysis: 57% and transplant: 67%). Generally, more males began dialysis than females each year, with their percentage ranging from 43% to 60%, except in 2023, where females predominated.

Males also dominated the new transplant patient statistics, except in 2022, when the gender distribution was equal (50% each), and in 2023, when females overtook males.

Table 11.4: Number of new dialysis and transplant patients by gender, 2017-2023

a) New Dialysis

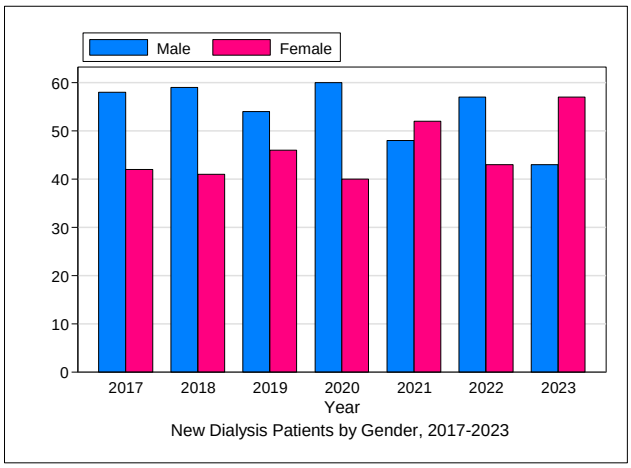
Year	Male		Female	
	n	%	n	%
2023	37	43	50	57
2022	56	57	42	43
2021	46	48	49	52
2020	56	60	38	40
2019	70	54	59	46
2018	53	59	37	41
2017	48	58	35	42

b) New Transplant

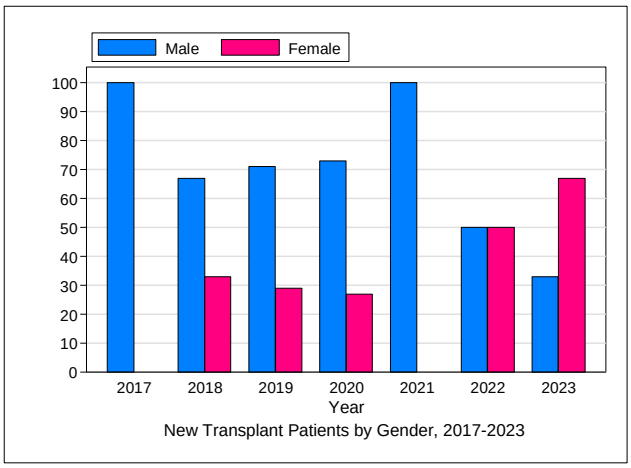
Year	Male		Female	
	n	%	n	%
2023	4	33	8	67
2022	3	50	3	50
2021	2	100	0	0
2020	8	73	3	27
2019	5	71	2	29
2018	4	67	2	33
2017	1	100	0	0

Figure 11.4: Number of new dialysis and transplant patients by gender, 2017-2023

a) New Dialysis



b) New Transplant

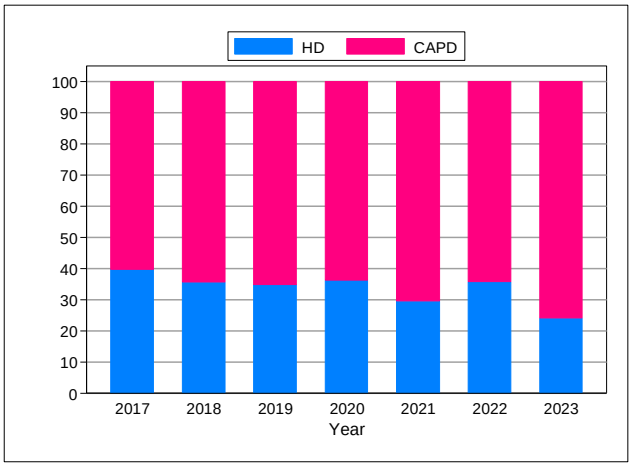


The percentage of new HD patients compared to Continuous Ambulatory Peritoneal Dialysis (CAPD) ranged from a high of 39.8% in 2017 to a low of 24.1% in 2023, indicating a general decrease in preference for HD over time relative to CAPD. CAPD consistently saw higher numbers of new patients than HD throughout the seven years, with the highest number recorded in 2019 (84 patients). There is a clear trend towards increasing preference for CAPD over HD among new dialysis patients. CAPD's share of new patients increased steadily, particularly in 2019.

Table 11.5: New dialysis by treatment modality, 2017-2023

Year	HD		CAPD	
	n	%	n	%
2023	21	24.1	66	75.9
2022	35	35.7	63	64.3
2021	28	29.5	67	70.5
2020	34	36.2	60	63.8
2019	45	34.9	84	65.1
2018	32	35.6	58	64.4
2017	33	39.8	50	60.2

Figure 11.5: New dialysis by treatment modality, 2017-2023

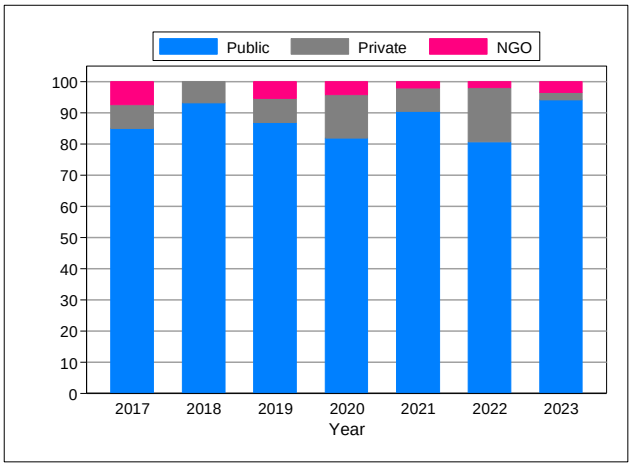


The public sector consistently treated the majority of new dialysis children each year, with percentages ranging from 81% to 94%. This indicates a firm reliance on public healthcare facilities for dialysis services.

Table 11.6: New dialysis by sector, 2017-2023

Year	Public		NGO		Private	
	n	%	n	%	n	%
2023	82	94	3	3	2	2
2022	79	81	2	2	17	17
2021	86	91	2	2	7	7
2020	77	82	4	4	13	14
2019	112	87	7	5	10	8
2018	83	93	0	0	6	7
2017	68	85	6	8	6	8

Figure 11.6: New dialysis by sector, 2017-2023



SECTION C: PRIMARY RENAL DISEASE

The most common primary renal disease identified was glomerulonephritis/SLE, which accounted for 32.5% in 2017 and showed a decreasing trend over the next seven years, ranging from 18.1% in 2020 to 27.6 % in 2023. The addition of CAKUT to our analysis revealed that it is a significant primary renal disease, with a prevalence ranging from 1.1% in 2018 to 11.5% in 2023. Obstructive uropathy exhibits variability over time, with the highest percentage observed in 2017 (7.2%) and lower values thereafter. Polycystic Kidney Disease shows minimal impact, with percentages around 1.1% in some years and 0% in others, indicating it is a less common cause of ESKD in this group. Unfortunately, in a significant proportion of children, ranging from 12.8% in 2020 to 22.4% in 2022, the primary renal disease is unknown, indicating potential gaps in diagnostic capabilities. Finally, a large percentage of renal diseases are classified under "Others", which may include less common or more complex conditions, peaking at 45.1% in 2021.

Table 11.7: Primary renal disease among new dialysis patients, 2017-2023

Year	2023	2022	2021	2020	2019	2018	2017
New Dialysis patients	87	98	95	94	129	90	83
% Unknown cause	20.7	22.4	13.7	12.8	18.6	16.7	22.9
% Diabetes Mellitus	0	0	0	0	2.3	1.1	0
% GN/SLE	27.6	18.4	23.2	18.1	24.8	25.6	32.5
% Polycystic kidney	0	1	0	0	0	1.1	0
% Obstructive Nephropathy	2.3	6.1	4.2	3.2	2.3	3.3	7.2
% CAKUT	11.5	5.1	5.3	8.5	0	1.1	0
% Toxic Nephropathy	0	2	1.1	3.2	0	1.1	0
% Hypertension	10.3	13.3	7.4	13.8	14.7	16.7	9.6
% Others	27.6	31.7	45.1	40.4	37.3	33.3	27.8

CAKUT= Congenital anomalies of the kidney and urinary tract

SECTION D: TYPES OF RENAL TRANSPLANTATION

Live donors (genetically related) represent the most common source of donor organs. The proportion of transplants from genetically related donors was high, reaching 100% in some years and maintaining a majority in others, with a peak of 11 cases in 2020. There were no commercial cadaver transplants across the entire period, while there was just one case of commercial live donor in 2022 (16.7%). Deceased donor transplants were done in 2017, 2018, 2022 and 2023. The use fluctuated, suggesting variability in the availability of deceased organs. In 2023, the number of transplants increased to 12, with equal numbers from live donors (50%) and deceased donors (50%). Over the last seven years, the overall trend has indicated a fluctuating but generally limited number of transplants.

Table 11.8: Types of renal transplantation, 2017-2023

Year	2023		2022		2021		2020		2019		2018		2017	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Commercial deceased donor	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial live donor (living unrelated)	0	0	1	16.7	0	0	0	0	0	0	0	0	0	0
Live donor (genetically related)	6	50	3	50	2	100	11	100	5	71.4	5	83.3	1	100
Live donor (emotionally related)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deceased donor (altruistic)	6	50	2	33.3	0	0	0	0	2	28.6	1	16.7	0	0
Live donor (unknown type)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown donor type	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**12**	**100**	**6**	**100**	**2**	**100**	**11**	**100**	**7**	**100**	**6**	**100**	**1**	**100**

SECTION E: SURVIVAL ANALYSIS

Over time, the survival rates for PD and HD patients gradually decrease, which is expected given the complications and challenges associated with long-term dialysis treatment. Transplant patients consistently show the highest survival rates, indicating that transplant is the most effective modality for long-term patient survival.

PD and HD show comparable survival rates; patients on PD generally have slightly better outcomes than those on HD.

Table 11.9(a): Patient survival by dialysis modality analysis (not censored with change of modality), 2017-2023

Modality	Transplant			PD			HD		
Interval (months)	n	% survival	SE	n	% survival	SE	n	% survival	SE
0	48	100		448	100		228	100	
6	36	98	2	391	98	1	206	98	1
12	31	98	2	324	95	1	173	94	2
24	26	98	2	227	90	2	129	89	2
36	22	98	2	152	87	2	102	85	3
48	14	98	2	106	81	3	75	81	3
60	6	98	2	47	75	4	45	74	4
72	2	98	2	19	66	5	24	70	5
84	1			1			1		

Figure 11.9(a): Patient survival by dialysis modality analysis (not censored with change of modality), 2017-2023

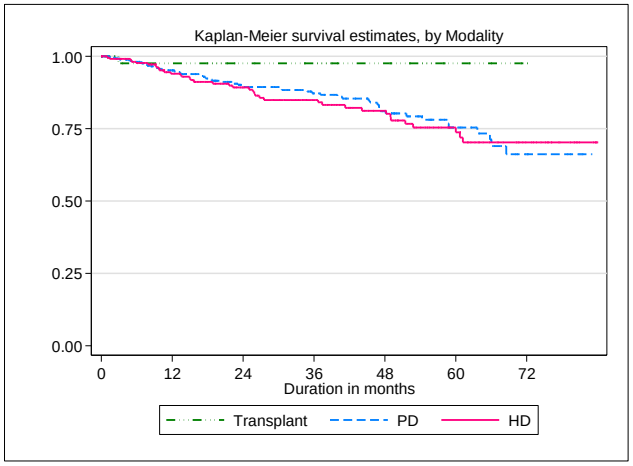


Table 11.10: Causes of death in dialysis patients, 2017-2023

Year	2023		2022		2021		2020		2019		2018		2017	
Causes of Death	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Cardiovascular	14	25	12	20.7	12	21.4	7	25	6	16.2	14	29.8	12	35.3
Died at home	5	8.9	10	17.2	9	16.1	7	25	5	13.5	11	23.4	5	14.7
Infection*	10	17.9	18	31	12	21.4	8	28.6	10	27	9	19.1	7	20.6
CRBSI	2	3.6	4	6.9	1	1.8	1	3.6	3	8.1	1	2.1	1	2.9
PD peritonitis	2	3.6	1	1.7	0	0	0	0	0	0	1	2.1	0	0
GIT bleed	0	0	1	1.7	1	1.8	0	0	0	0	0	0	0	0
Cancer	2	3.6	0	0	0	0	0	0	0	0	0	0	0	0
Liver disease	0	0	5	8.6	0	0	1	3.6	0	0	0	0	1	2.9
Withdrawal	1	1.8	0	0	0	0	0	0	1	2.7	1	2.1	0	0
Accidental Death	1	1.8	3	5.2	9	16.1	2	7.1	10	27	6	12.8	2	5.9
Pulmonary Causes	5	9	0	0	0	0	0	0	0	0	0	0	0	0
Others	8	14	4	7	8	14	1	4	1	3	0	0	3	9
Unknown	6	11	0	0	4	7	1	4	1	3	4	9	3	9
Total	**56**	**100**	**58**	**100**	**56**	**100**	**28**	**100**	**37**	**100**	**47**	**100**	**34**	**100**

** Died due to COVID-19 (2023: HD 0, PD 0, 2022: HD 4, PD 3; 2021: HD 5, PD 2)*

Cardiovascular disease remained the leading cause of death in most years, with the highest percentage in 2017 (35.3%) and the lowest in 2019 (16.2%). In 2023, cardiovascular diseases contributed 25% to the overall causes of death. Infections also consistently contributed to a large proportion of deaths, peaking in 2022 (31%) and the least in 2023 (17.9%). Dying at home represents a substantial portion, ranging from 8.9% to 23.4%, which may suggest issues such as sudden health declines or options for conservative care. Cardiovascular and infection-related deaths remain the top two consistent causes across the years. In 2023, infections, CRBSI and PD peritonitis together contributed 25.1% of the deaths, equalling cardiovascular causes.

Table 11.11: Reasons for drop-out from PD program, 2017-2023

Year	2023		2022		2021		2020		2019		2018		2017	
Reasons	n	%	n	%	n	%	n	n	%	n	%	n	%	n
Death	23	25.8	27	46.6	23	41.8	13	25.5	19	33.9	14	28	19	35.8
Transplant	8	9	4	6.9	2	3.6	10	19.6	5	8.9	7	14	2	3.8
PD infections	18	20.2	11	19	20	36.4	7	13.7	9	16.1	10	20	13	24.5
Inadequate dialysis	13	14.6	3	5.2	2	3.6	1	2	6	10.7	7	14	8	15.1
Catheter-related issues	16	18	8	13.8	6	10.9	11	21.6	12	21.4	7	14	2	3.8
Social reasons	7	7.9	3	5.2	1	1.8	5	9.8	3	5.4	3	6	3	5.7
Others	4	4.5	1	1.7	1	1.8	4	7.8	2	3.6	1	2	3	5.7
Unknown	0	0	1	1.7	0	0	0	0	0	0	1	2	3	5.7
Total	**89**	**100**	**58**	**100**	**55**	**100**	**51**	**100**	**56**	**100**	**50**	**100**	**53**	**100**

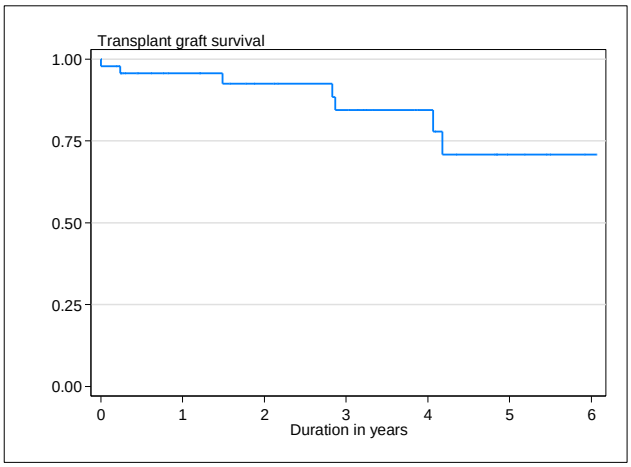
Death is the most common reason for drop-out, with the highest percentage in 2022 (46.6%). This trend indicates that mortality remains a significant challenge in maintaining long-term PD treatment. PD infections are major medical complications leading to drop-out, with a peak in 2021 (36.4%). This points to the fact that infection control remains a critical area for intervention in PD management. In 2023, both death and PD infection showed a decrease in percentage. Another significant contributor is catheter-related issues, consistently leading to drop-out; the percentage was notably high in 2020 (21.6%).

The graft survival for paediatric transplants was 92% at one year and 71% at five years.

Table 11.12: Transplant graft survival, 2017-2023

Interval (months)	n	% survival	SE
0	47	100	
6	33	96	3
12	27	92	4
24	22	84	7
36	14	84	7
48	6	71	10
60	2	71	10
72	1		
84	1		

Figure 11.12: Transplant graft survival, 2017-2023



The commonest known cause for graft loss among paediatric transplants was rejection. The most frequently cited cause over the seven years, peaking at 55.6% (5 cases) in 2022. The rejection percentage was 37.5% in 2023. However, it is worth noting that the rejection percentages have significantly decreased compared to the past decade.

Graft loss due to unknown causes showed a significant percentage in 2017 (50%) and 2020 (33.3%), and remains present almost every year, not because the causes of graft loss are unknown, but because notification of the outcome of graft loss was indirect, and hence no cause was entered. Improved diagnostic capabilities and effective record-keeping helped decrease the percentage of unknowns from 50% in 2017 to 25% in 2023.

Table 11.13: Causes of graft failure, 2017-2023

Year	2023		2022		2021		2020		2019		2018		2017	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Rejection	3	37.5	5	55.6	0	0	0	0	3	50	4	36.4	0	0
Calcineurin toxicity	1	12.5	0	0	0	0	0	0	0	0	1	9.1	0	0
Other drug toxicity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Infection	0	0	0	0	1	25	0	0	0	0	0	0	0	0
Vascular causes	0	0	0	0	0	0	0	0	0	0	1	9.1	0	0
Recurrent/ de novo renal disease	0	0	0	0	0	0	0	0	0	0	0	0	1	50
Chronic allograft nephropathy / IFTA	1	12.5	3	33.3	0	0	2	33.3	1	16.7	0	0	0	0
Technical problem	1	12.5	0	0	0	0	0	0	0	0	0	0	0	0
Others	0	0	1	11.1	3	75	2	33.3	2	33.3	1	9.1	0	0
Unknown	2	25	0	0	0	0	2	33.3	0	0	4	36.4	1	50
Total	**8**	**100**	**9**	**100**	**4**	**100**	**6**	**100**	**6**	**100**	**11**	**100**	**2**	**100**

SECTION F: HAEMODIALYSIS PRACTICE

The majority of the paediatric HD patients had native vascular access. Wrist AVF was the most common type, with percentages ranging from 39.3% in 2017 to 35.8% in 2023. Brachiocephalic fistula (BCF) was the second most frequent access, with a rate of around 30% throughout the years. Cuffed central venous catheters have a relatively high usage rate of approximately 20% and have remained stable over time. Cuffed catheters are a longer-term temporary solution when a fistula cannot be created. The consistent use of catheters, especially cuffed ones, highlights ongoing challenges in creating or maintaining permanent access for the paediatric population.

Table 11.14: Vascular access on haemodialysis, 2017-2023

Access types	2023		2022		2021		2020		2019		2018		2017	
	n	%	n	%	n	%	n	n	%	n	%	n	%	n
Wrist AVF*	192	35.8	199	36.6	200	36.3	203	36.9	204	37.2	204	39.4	199	39.3
BCF*	151	28.1	159	29.2	169	30.7	173	31.5	171	31.2	162	31.3	160	31.6
BBF*	28	5.2	27	5	23	4.2	22	4	16	2.9	14	2.7	16	3.2
Graft	4	0.7	5	0.9	5	0.9	7	1.3	7	1.3	6	1.2	4	0.8
HD Catheter - Cuffed	118	22	113	20.8	117	21.2	109	19.8	118	21.5	105	20.3	101	20
HD Catheter - Non-Cuffed	44	8.2	41	7.5	37	6.7	36	6.5	32	5.8	27	5.2	26	5.1
Total	**537**	**100**	**544**	**100**	**551**	**100**	**550**	**100**	**548**	**100**	**518**	**100**	**506**	**100**

**AVF = arteriovenous fistula, BBF = brachiobasilic fistula, BCF = brachiocephalic fistula*

The mean Kt/V over the years ranged from 1.7 to 1.8, indicating relatively high dialysis adequacy.

A high percentage of patients achieved a Kt/V of ≥1.2, consistently around 94% to 96% throughout the years. This suggests that effective dialysis treatment is available across the patient population.

Table 11.15(a): Distribution of delivered Kt/V, HD patients 2017-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients ≥1.2	% patients ≥1.3
2023	478	1.7	0.4	1.7	1.4	1.9	96	90
2022	504	1.7	0.4	1.7	1.5	1.9	94	86
2021	494	1.7	0.3	1.6	1.4	1.9	94	89
2020	496	1.8	0.4	1.7	1.5	2	96	90
2019	482	1.8	0.4	1.8	1.5	2.1	96	90
2018	444	1.8	0.4	1.8	1.5	2	96	91
2017	459	1.8	0.5	1.7	1.5	2	96	89

The mean URR ranged from 74.3% in 2021 to 76.7% in 2019, indicating effective dialysis treatment across the years. High percentages of patients consistently exceed the threshold of 65% URR, with figures ranging from 92% to 96% across the years, showcasing consistent and quality dialysis treatment.

Table 11.15(b): Distribution of URR, HD patients 2017-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% patients ≥65%	% patients ≥70%
2023	478	75.2	6.6	75.9	70.9	79.7	92	78
2022	504	75.1	6.7	75.7	71.1	80	91	80
2021	493	74.3	6.9	75.3	70.1	79.4	92	75
2020	495	75.6	7.5	76.2	71.2	81.2	92	80
2019	482	76.7	6.6	77.3	72.6	81.6	95	84
2018	443	76.5	6.7	77.1	72.3	81.3	96	81
2017	456	76.1	7.5	76.5	72.2	81.3	93	81

SECTION G: ANAEMIA

The use of erythropoietin is consistently high, ranging from 92% to 95% over the seven years among HD patients. Similarly, the proportion of children receiving parenteral iron showed an encouraging upward trend from 50% in 2017 to 52% in 2022, while the percentage of children on oral iron had a notable reduction from 29% in 2017 to 24% in 2022. Blood transfusion rates varied slightly, ranging from 9% to 12%.

Table 11.16: Treatment for anaemia, HD patients 2017-2023

Year	Number of patients	% on ESAs	% received blood transfusion	% on oral iron	% received parenteral iron
2023	526	94	10	32	50
2022	543	93	10	24	52
2021	544	93	12	14	52
2020	541	94	9	17	48
2019	532	95	10	21	44
2018	507	92	10	26	46
2017	499	92	11	29	50

The mean transferrin saturation (TSAT) values ranged from 31.4% in 2018 to 34.6% in 2023, indicating a relatively stable iron status among the HD patient cohort over the seven years. The percentage of patients with TSAT ≥ 20% generally increased over the years, with a noticeable rise from 81% in 2019 to 86% in 2023.

Table 11.17: Distribution of transferrin saturation on Erythropoietin, HD patients 2017-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2023	429	34.6	15	32.1	24.9	41.6	86
2022	461	33.3	14.4	31.1	23.7	39.9	85
2021	470	34.1	15.5	30.7	23.6	40.7	86
2020	473	32.6	14.3	29.9	23.4	38.5	85
2019	460	31.6	14.4	28.8	22.4	37.2	81
2018	430	31.4	13.4	29	22.3	37.2	84
2017	416	32.1	14.6	28.9	22.6	38.8	83

For the PD patient cohort, the mean TSAT values over the seven years indicate slight variability, but generally high levels, ranging from 33.9 to 37.6. The percentage of patients with TSAT ≥20% has shown high and improving figures, ranging from 85% to 90%.

Table 11.18: Distribution of transferrin saturation on Erythropoietin, PD patients 2017-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2023	338	33.9	14.7	31.7	24.1	41.4	85
2022	334	35.5	15.9	33.3	23.3	42.7	87
2021	295	37.1	16.3	33.9	26.2	44.3	89
2020	279	37	16.6	34	24.4	45.7	88
2019	269	37	17.3	33.8	25.2	44.5	85
2018	225	37.6	16.4	33.9	24.8	47.3	88
2017	210	36.9	16.6	33.9	25.2	44.9	90

The median weekly dose of Epoetin has consistently been 4,000 units per week over the seven years. The mean weekly dose decreased from 5700 units per week (2017) to 4176 units per week (2023). This is reflective of better anaemia control.

Table 11.19: Distribution of Epoetin alfa & beta dose (u/week), 2017-2023

Year	Number of patients	Mean	SD	Median	LQ	UQ
2023	879	4176.1	3542.8	4000	2000	6000
2022	716	5315.2	3335.2	4000	2000	6000
2021	724	5464.4	3384.5	4000	4000	6000
2020	716	5467.9	3288.1	4000	4000	6000
2019	813	5388.7	3170.9	4000	4000	6000
2018	739	5564.3	3231.6	4000	4000	8000
2017	707	5689.3	3200.1	4000	4000	8000

APPENDIX I

DATA MANAGEMENT

Introduction

Data integrity of a register begins from the data source, data collection tools, data verification and data entry process. Registry data is never as perfect as clinical trial data. Caution should be used when interpreting the results.

Data source

The initial phase of the data collected in the Malaysian Dialysis and Transplant Registry (MDTR) covered all renal replacement therapy (RRT) patients in the Ministry of Health program since its inception in the early 1970s. The Register subsequently received data from other sectors of RRT providers, e.g., from private sector, non-government organisations (NGOs), armed forces, and universities.

MDTR continues to actively ascertain new RRT centres in the country. The mechanism of ascertainment is through feedback from dialysis related companies, current Source Data Providers (SDPs) and public information. This will gradually and eventually result in a complete RRT centre database. The identified RRT centre is invited to participate in data collection.

Participation in the MDTR which was entirely voluntary prior to 2006 is now made compulsory by the Private Health Care Facilities and Services Act 1998, and its Regulations 2006, which was implemented on 1st May 2006. This however applies to private and NGO centres, and data submission from centres managed by the Ministry of Health, Ministry of Defence or public Universities is voluntary. RRT centres which have expressed interest in participating will be recruited as SDPs.

In 2023, there are 61 new haemodialysis (HD) centres, 5 new peritoneal dialysis (PD) centres and 1 new kidney transplant (TX) follow-up centres. 29 HD centres had ceased operation. Centres contributing data are shown below:

Table I: Data Submission, 2023

	Known centres	**Centres contributed data***		**Centres contributed annual return**	
	(n)	(n)	(%)	(n)	(%)
Haemodialysis	984	970	98.6	970 #	98.6
Peritoneal Dialysis	69	60	87.0	60 +	87.0
Kidney Transplant	53	49	92.5	49 ~	92.5
All modalities	1106	1079		1079	

** Data contributed – Patient Notification, Outcome Notification, and/or Annual Return Form*

 # 885 HD centres had 100% submission of annual treatment return, and 79 HD centres had submitted 80% - <100% of annual treatment return.

+ 56 PD centres had 100% submission of annual treatment return, and 3 PD centres had submitted 80% - <100% of annual treatment return.

~ 44 Transplant centres had 100% submission of annual treatment return, and 1 Transplant centres had submitted 80% - <100% of annual treatment return.

Table II: Participation in annual treatment return, 2023

	Total Annual Return	**Annual Return Submitted**	**Annual Return Submission Rate**
	(n)	(n)	(%)
HD patient data submission	56726	56364	99.4
PD patient data submission	8560	8553	99.9
TX patient data submission	2450	2380	97.1

Data collection

In 2017, NRR has upgraded the data collection processes from a paper based to a web-based system and this was named eNRR. eNRR is more efficient and will enable SDPs the ability to access and tabulate their data on-line. The notifications forms are submitted periodically or whenever there is an incident. Annual return forms for the assessment year should submitted not later than February of the following year. The forms are:

- Patient notification form
- Outcome notification form
- Annual Return form
- Work related rehabilitation and quality of life assessment form – annual assessment

MDTR collects patients' demographic details, clinical data, dialysis treatment data, transplant data, peritonitis data and outcome data. MDTR holds individual patient's identifiable data that allow complete follow-up despite patient transfers from one centre to another or change of modality which are especially common among the RRT patients. These patients are monitored and tracked through from the time they were registered until their death. For those patients who were lost to follow-up, MDTR will verify their outcome with the National Registration Department's data. Patient profiles are submitted to the Register throughout the year. The identity of patients in the database is not released publicly or in the registry reports.

Centre-specific reports are generated and forwarded to SDPs on a quarterly basis. This has generated increased feedback from SDPs, and improved the patient ascertainment rate and the accuracy of the data transmittal in the registry.

Database system

The Register initial database was created in DBASE IV in a single computer environment in the 1990s. It was then upgraded to Microsoft Access, Microsoft Visual Basic .NET enterprise system and local server Java platform enterprise system over the years and used by NRR office personnel. Starting from 2017, NRR has been opened for data entry by all site users through eNRR web application which is running on Java platform and using Microsoft SQL Server as database.

Data management personnel

The data management personnel in the Register office are trained based on the standard operating procedures (SOP).

The data entry process is designed to enhance data quality. Quality assurance procedures are in place at all stages to ensure the quality of data.

Visual review, data entry and de-duplication verification, data editing

On receiving the notification forms submitted by SDPs, the eNRR system is able to check for obvious error or missing data in the compulsory fields; data submission will not be allowed by the system if a critical variable is missing or ambiguous.

After passing the duplicate check, the data is entered and coded where required. Edit checks are performed against pre-specified validation rules to detect missing values, out of range values or inconsistent values. Any data discrepancy found will be listed in [Data Query] module, and the SDP must verify each query.

Data coding, data cleaning / data analysis

Those data in text fields will be manually coded by the Register manager and reviewed by the MDTR Editors. A final edit check run is performed to ensure that data is clean. All queries are resolved before dataset is locked and exported to the statistician for analysis.

Data release and publication policy

One of the primary objectives of the Registry is to make data available to the renal community. There are published data in the registry's annual report on the website: http://www.msn.org.my. This report is copyrighted. It may be freely reproduced without the permission of the National Renal Registry. Acknowledgment would be appreciated. Suggested citation is Hooi LS, & Ong LM. (Eds.). 2025. Thirty-first Report of the Malaysian Dialysis and Transplant 2023, Kuala Lumpur. https://www.msn.org.my/.

A distinction is made between use of NRR results (as presented in NRR published report) and use of NRR data in a publication. The former is ordinary citation of published work. NRR encourages such citation whether in the form of presentation or other write-ups. The latter constitutes original research publication. NRR position is as follows:

The NRR does not envisage independent individual publication based entirely on NRR published results, without further analyses or additional data collection.

NRR agrees that investigator shall have the right to publish any information or material arising in part out of NRR work. In other words, there must be additional original contribution by the investigator in the work intended for publication.

NRR encourages the use of its data for research purposes. Any proposed publication or presentation (e.g., manuscript, abstract or poster) for submission to journal or scientific meeting that is based in part or entirely on NRR data should be sent to the NRR prior to submission. NRR will undertake to comment on such documents within 4 weeks. Acknowledgement of the source of the data would be appreciated.

Any formal publication of a research based in part or entirely on NRR data in which the input of NRR exceeded that of conventional data management and provision will be considered as a joint publication by investigator and the appropriate NRR personnel.

Any party who wishes to request data for a specific purpose that requires computer-run should make such requests in writing (by e-mail) accompanied by a Data Release Application Form and signed Data Release Agreement Form. Such request will require approval by the Advisory Board before the data can be released.

APPENDIX II

ANALYSIS SETS, STATISTICAL METHODS AND DEFINITIONS

Analysis sets
This refers to the sets of cases whose data are to be included in the analysis.

Six analysis sets were defined:

1. Dialysis patient notification between 2014 and 2023
This analysis set consists of patients commencing dialysis between 2014 and 2023. This analysis set was used for the analysis in Chapter 1, 2 and 3.

Since 1993, the MDTR conducted an annual survey on all dialysis patients to collect data on dialysis and drug treatment, clinical and laboratory measurements. All available data were used to describe the trends in these characteristics. For this analysis in relation to these characteristics, only data from 2014 onwards were used. Missing data in this analysis set was imputed using first available observation carried backward or last observation carried forward. This analysis set was used for the analysis in Chapters 4 to 7.

2. New Dialysis Patients
The number of new dialysis patients was based on the first dialysis treatment of the patients. Patients who convert from one dialysis modality to another (from HD to PD or vice versa) are not counted as new patients. If transplant is the 1st modality and patient's kidney transplant failed and he received dialysis, then for RRT count, the patients will be counted twice. However, if the patients receive transplant between the dialysis, then the dialysis after transplant will be counted if the transplant last for more than 90 days while if it is less than or equal to 90 days, then the dialysis after the transplant will not be counted. This analysis set definition was used in Chapters 1 and 2.

3. Peritonitis data
Analysis was confined to chronic PD patients who were on peritoneal dialysis from 2014 to 2023. This analysis set was used for the analysis in Section 9.4.

4. Renal transplant data
This analysis set was confined to patients who had undergone renal transplantation from 2014 to 2023. This analysis set was used for the analysis in Chapter 10.

5. Diabetes Mellitus
Prior to 2017 when data was submitted in paper form, primary and secondary causes of renal disease were allowed. The National Renal Registry (NRR) office adjudicated discrepancies in the data submitted to determine the primary renal disease (PRD). If the PRD was recorded as unknown and patient has diabetes as the secondary cause or diabetes was included as a co-morbidity, the PRD was amended to diabetes. If there was a discrepancy in PRD reported between centres, one as unknown and the other as diabetes, the PRD was amended to diabetes

In 2017 data collection migrated to eNRR, an online electronic form. From 2017 and 1st February 2021, the system allowed more than one PRD. The determination of PRD was based on the following algorithm:

- If both unknown and diabetes were selected as PRD, diabetes was recorded as the PRD
- If the PRD was recorded as unknown and diabetes was included as a co-morbidity, the PRD was amended to diabetes.
- If there was a discrepancy in PRD reported between centres, the PRD at first notification was used
- If multiple PRDs were entered, the order for PRD determination is as follows: -
    i. ADPKD
    ii. Hereditary nephritis, specify
    iii. Glomerulonephritis, specify
    iv. Obstructive uropathy, specify
    v. Drugs / toxic nephropathy
    vi. Diabetes Mellitus
    vii. Hypertension
    viii. Others, specify
    ix. Unknown

Examples:

- *If 'Unknown' & 'diabetes' were selected as PRD then PRD is diabetes*
- *If 'diabetes' & 'ADPKD' were selected as PRD then PRD is ADPKD*
- *If 'Unknown' was selected as PRD and comorbidities include diabetes then PRD is diabetes*
- *If 'Unknown' was selected as PRD and comorbidities include hypertension then PRD is hypertension change in PRD is permitted with written request and documentation from the source data providers to NRR*

From 2nd February 2021 onwards

- Only a single entry for PRD is permitted
- If there was a discrepancy in PRD reported between centres, the PRD at first notification was used
- If PRD is unknown and diabetes is included in comorbidity at notification, "Unknown" PRD is maintained
- If 'Unknown' was selected as PRD and comorbidities include hypertension, then PRD is "Unknown"
- Change in PRD is permitted with written request and documentation from the source data providers to NRR

Statistical methods

1. Population treatment rates (new treatment or prevalence rates)

Treatment rate is calculated by the ratio of the count of number of new patients or prevalent patients to the mid-year population of Malaysia in that year, expressed in per million-population. Results on distribution of treatment rates by state are also expressed in per million-population in the state since states obviously vary in their population sizes.

2. Adjusted Mortality of dialysis patients

Cox proportional hazards model was considered for mortality of the patients adjusted with demographic and laboratory variables. This analysis was used in Chapter 3 and 10.

3. Analysis of trend of intermediate results

For summarizing intermediate results like continuous laboratory data, we have calculated summary statistics like mean, standard deviation, median, lower quartile, upper quartile and the cumulative frequency distribution graph is plotted by year. Cumulative distribution plot shows a listing of the sample values of a variable on the X axis and the proportion of the observations less than or greater than each value on the Y axis. An accompanying table gives the Median (50% of values are above or below it), upper quartile (UQ, 25% of values above and 75% below it), lower quartile (LQ, 75% of values above and 25% below it). Other percentiles can be read directly off

the cumulative distribution plot. The table also shows percent of observations above or below a target value, or with an interval of values; the target value or interval obviously vary with the type of laboratory data. The choice of target value is guided by published clinical practice guidelines, or otherwise they represent consensus of the local dialysis community. This analysis was used in Chapter 4, 5, 6, 7, 8, 9 and 10.

4. Centre variation

To compare the variation of the intermediate results between centres, graphs describing intermediate results in each centre are presented. The 95% confidence intervals have been calculated using the normal approximation of the Poisson to show the variation of proportion in centres. Lower quartile and upper quartile are instead plotted in comparison of variation in median among centres. An accompanying table gives the summary statistics like minimum, 5th percentile, lower quartile, median, upper quartile, 95th percentile and maximum value among centres over year. Centres with intermediate results for <10 patients were combined into one composite centre. This analytical method was used in Chapter 4, 5, 6, 7, 8 and 9.

5. Cause of Death

As each patient can have more than one reason for death, the main cause of death is selected in the following hierarchy: -

i. Covid 19 (Covid-19 is tabulated under infection)
ii. Peritonitis from CAPD (if applicable)
iii. CRBSI from HD (if applicable)
iv. Accident
v. Cancer
vi. Withdrawal of RRT
vii. Died suddenly at home
viii. Gastrointestinal hemorrhage
ix. Infection (besides Covid-19, PD peritonitis and CRBSI)
x. Liver disease
xi. Lung disease
xii. Cardiovascular disease
xiii. Other
xiv. Unknown

The analysis method was used in Chapter 3 and 11.

6. Patient Drop Out

As each PD patient can have more than one reason for drop-out, the main reason of patient drop-out is selected based on the following hierarchy: -

i. Death
ii. Transplant
iii. PD Infections
iv. Inadequate Dialysis
v. Catheter related issues
vi. Social reasons
vii. Others
viii. Unknown

The analysis method was used in Chapter 9.

7. Cause of Graft Failure

As each Transplant patient can have more than one reason for graft failure, the main reason for graft failure is selected based on the following hierarchy: -

i. Rejection
ii. Calcineurin toxicity
iii. Other drug toxicity
iv. Ureteric obstruction
v. Infection
vi. Vascular causes
vii. Recurrent / de novo renal disease
viii. Chronic allograft nephropathy / IFTA
ix. Technical problem
x. Others
xi. Unknown

The analysis method was used in Chapter 10.

Death rate calculation

Annual death rates were calculated by dividing the number of deaths in a year by the estimated mid-year patient population.

Incidence rate ratio

The incidence rate is determined by dividing the number of new cases of a disease or condition in a specific population over a given period of time by the total population. Therefore, incidence rate ratio is the comparison of two groups in terms of incidence rate. Poisson regression model was considered to estimate the independent effect of each factor, expressed as incidence rate ratio. An incidence rate ratio of 3 means that group 2 have the rate 3 times higher than group 1 when group 1 is the reference group.

Standardized mortality rate

The cohort considered for this analysis was patients who were on dialysis in 2021 and new patients in 2022 by modality.

SMR is a ratio between the observed number of deaths with the expected, based on the age group, diabetic, serum album group, diastolic blood pressure group and hemoglobin group rates in a standard population and the age group, diabetic, serum album group, diastolic blood pressure group and haemoglobin group distribution of the study population. If the ratio is observed: expected death is greater the 1.0, we conclude that there is “excess death” in the study population. SMR was generated using the following formula:

SMR = observed death / expected death

Risk adjusted mortality rate (RAMR)

When the mortality rate is risk adjusted, the information becomes more comparable among the hospitals because the data is adjusted to account for variations in patients’ severity of renal disease and their risk of mortality. RAMR was generated using the following formula:

RAMR = SMR x AvMR, where AvMR is the average of the overall observed mortality rate

Risk ratio

Risk ratio is the relative measure of the difference in risk between the exposed and unexposed populations in a cohort study. The relative risk is defined as the rate of disease among the exposed divided by the rate of the disease among the unexposed. A relative risk of 2, means that the exposed group has twice the disease risk as the unexposed group.

Survival analysis

The unadjusted survival probabilities were calculated using the Kaplan-Meier method, in which the probability of surviving more than a given time can be estimated for members of a cohort of patients without accounting for the characteristics of the members of that cohort.

To estimate the difference in survival of different subgroups of patients within the cohort, a stratified proportional hazards model (Cox) was used where appropriate. The results from Cox model are interpreted using a hazard ratio. Adjusted survival probabilities are adjusted for age, gender, primary diagnosis and time on RRT. For diabetics compared with non-diabetics, for example, the hazard ratio is the ratio of the estimated hazards for diabetics relative to non-diabetics, where the hazard is the risk of dying at time t given that the individual has survived until this time. The underlying assumption of a proportional hazards model is that the ratio remains constant throughout the period under consideration.

Technique failure is defined as occurrence of death or transfer to another modality of dialysis. Similarly, graft failure is defined as occurrence of death or returned to dialysis.

Patient survival was considered in two ways:

Survival censored for change of modality based on first modality. Duration survival for patients will be calculated from the date commencing the first modality till first modality outcome. Hence duration after the change modality or transplant will not be considered. Death occurring during the first modality will be considered in the analysis since patients will be censored for change of modality before death.

Survival is not censored for change of modality based on first modality. Duration survival for patients will be calculated from the date commencing the first modality till 31 Dec 2023 for patients who were still on RRT. For patients who died, duration of survival will be calculated from date commencing the first modality till date of outcome which is death. All death outcomes whether occurring during first modality or after change in modality will be considered for this analysis.

Survival of incident patients by centre

1-year survival

The cohort considered for this analysis was considered from 2013-2022. Many patients commencing dialysis in 2023 would still not have completed one year.

5-year survival

The cohort considered for this analysis was considered from 2013-2018. This is due to those commence from 2019 onwards still not able to have 5-year survivals analysis.

Funnel plot

This analysis was confined to new dialysis patients from year 2014-2023. The figure is included to assess whether survival probability adjusted to age and diabetes of each centre is likely to be different from the national average. This plot was used in Chapter 3.

Peritonitis rate

The occurrence of peritonitis is expressed as number of episodes per patient-year of observation; peritonitis rate in short. Relapse peritonitis is defined as peritonitis caused by the same organism occurring within 6 weeks of diagnosis of previous peritonitis.